⑤-1

DRAFT

February 19, 1997

DRAFT FOR RELEASE

Ms. Sandy Stash
Montana Facilities Manager
ARCO
307 E. Park Avenue
Suite 301
Anaconda, MT 59711

Dear Sandy:

As you know, representatives of Atlantic Richfield Company ("ARCO") and representatives of Butte-Silver Bow ("BSB") have been engaged in discussions relating to post-remediation activities to be jointly undertaken by ARCO and BSB at the property commonly known and referred to as the Clark Tailings and Old BSB Landfill. BSB believes that it has come to a general understanding in principle with ARCO with regard to the post-remediation activities and intends, upon the concurrence of ARCO, to proceed with the negotiation of a binding and legally enforceable Agreement by and between ARCO and BSB consistent with the following general parameters:

1. Construction of Recreational Facility.

In any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, ARCO would agree to design and construct a first-class, high-quality recreational facility at the Clark Tailings area and Old BSB Landfill following completion of on-site remediation activities required by the United States Environmental Protection Agency and/or the Montana Department of Environmental Quality. The recreational complex would consist of several well-designed and constructed components, including six baseball fields, two "Little Guy" football fields, a golf driving range, a multi-function building with concession stand space, public use area, restroom facilities, storage area and equipment garage, an outdoor amphitheater, picnic areas, an entry road, parking areas, nature trails and other mutually agreed to recreational amenities, as illustrated in Attachment A. ARCO would agree to design and construct all recreational amenities represented and depicted on Attachment A. The final design of such recreational facility would be mutually agreed to by ARCO and BSB. It is understood that the financing to design and construct the facility would be provided by ARCO as part of its remediation activities, and in-kind services to install water and sewer line extensions to support the facility would be provided by BSB.

DRAFT

2. Operation and Maintenance.

Except as provided in paragraph 5 below, in any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, BSB would agree to operate and maintain the recreational facility referred to in paragraph 1 above at its sole expense, exclusive of all areas not developed for recreational use which shall be maintained as provided in paragraph 5.

3. Future Remediation.

Except as provided in this paragraph and paragraph 5 below, in any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, BSB would agree, as between ARCO and BSB, to be solely responsible for all future remediation actions required by the United States Environmental Protection Agency and/or the Montana Department of Environmental Quality with respect to the Old BSB Landfill unless such future remediation activities are required, in whole or in part, as a result of the acts or omissions of ARCO in the design and/or construction of the currently proposed remediation. In the event that such future remediation activities are required, as a result of such acts or omissions of ARCO, ARCO would agree, as between ARCO and BSB, to be solely responsible for such future remediation activities.

Except as provided in this paragraph and paragraph 5 below, in any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, ARCO would agree, as between ARCO and BSB, to be solely responsible for all future remediation actions required by the United States Environmental Protection Agency and/or the Montana Department of Environmental Quality with respect to the Clark Tailings unless such future remediation activities are required, in whole or in part, as a result of acts or omissions of BSB as related to the performance of duties under an operations and maintenance plan to be mutually agreed to by ARCO and BSB. In the event that such future remediation activities are required, in whole or in part, as a result of acts or omissions of BSB, BSB would agree, as between ARCO and BSB, to be solely responsible for such future remediation activities.

4. Currently Planned Remediation.

In any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, ARCO and BSB would agree to fully support the currently proposed remediation of the Clark Tailings and the Old BSB Landfill, as specified in the Old BSB Landfill/Clark Tailings Corrective Measures Assessment Report and Addendum No. 1 to the Lower Area One Final Work Plan/Design Report. With regard to the actions specified in these two documents, it is understood that, as between ARCO and BSB, ARCO would be solely responsible for the implementation of the currently proposed remediation of the Clark Tailings and BSB would be solely responsible for the implementation of the currently proposed remediation of the Old BSB Landfill.

DRAFT

5. **Monitoring and Maintenance.**

In any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, BSB would agree, as between ARCO and BSB, to be solely responsible for all on-site and off-site monitoring and maintenance activities required by the United Stated Environmental Protection Agency and/or the Montana Department of Environmental Quality with respect to the Clark Tailings and/or Old BSB Landfill. It is understood that the financing of all such monitoring and maintenance activities associated with the Clark Tailings would be provided by ARCO as part of a permanent Institutional Controls Program for Superfund reclaimed areas; such financing shall be negotiated during the construction period and be put in place on or before July 1, 1999, when monitoring and maintenance activities are expected to commence. It is understood that the financing of all such monitoring and maintenance activities associated with the Old Butte Landfill would be provided by BSB.

6. **Permits, Approvals and Access.**

In any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, ARCO and BSB would agree that all of their respective duties and obligations would at all times and in all respects be subject to the prior receipt, by agreed upon deadlines, of all necessary and appropriate permits and approvals from federal, state and local governmental entities and all necessary and appropriate rights of access and easements from property owners.

7. **Arbitration.**

In any binding and legally enforceable Agreement negotiated by and between ARCO and BSB, ARCO and BSB would include a mutually acceptable provision requiring arbitration of disputes.

If ARCO is in concurrence with the general parameters outlined above, please indicate ARCO's concurrence by signing this letter in the space provided below and returning a copy to me.

Butte-Silver Bow

By: ______________________________
Jack Lynch, Chief Executive

DRAFT

Concurrence:

Atlantic Richfield

By: ______________________________ Date: ______________________________
Sandra M. Stash

Silver Bow Co. cu
Old Butte L.F. #20
~~CMA~~
G. Water Corr. Measures

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

February 14, 1997

F. Patrick Crowley
Solid Waste Program Manager
Montana Department of Environmental Quality
1520 East Sixth Ave.
P.O. Box 200901
Helena, Montana 59620-0901

RECEIVED
FEB 18 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Dear Pat:

Enclosed are two copies of two additional design sheets for the Clark Tailings disposal area. These drawings reflect the plans to line the area around the Timber Butte Sedimentation Basin, as described in the *Final Draft, Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment*. Please attach these sheets (C-22 and C-23) to the set of design drawings submitted on January 24, 1997.

Additional revisions we have discussed will also be incorporated after we receive your comments on the draft drawing submittal. These include changing detail 2, sheet C-18 to show the Type I ditch lined with geosynthetic clay liner rather than the typical cap section. The extent of surficial tailings to be excavated and placed within the Clark Tailings area will be modified on Sheet C-3 based on the findings of the test pits recently installed in this area. The test pit data are included in the *Final Draft, Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment*.

We look forward to receiving your comments on the draft drawings, specifications, and construction quality assurance plan submitted on January 24 so that we may finalize these documents and be prepared for construction when the public comment period is completed.

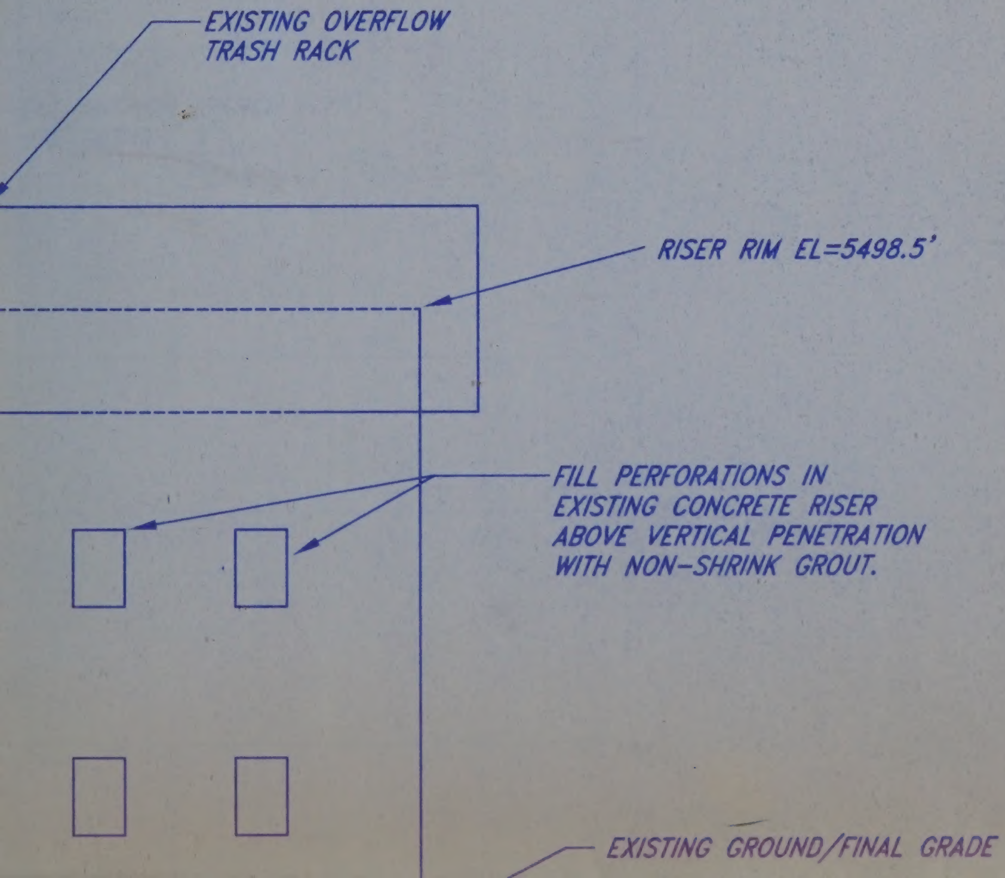
Sincerely,

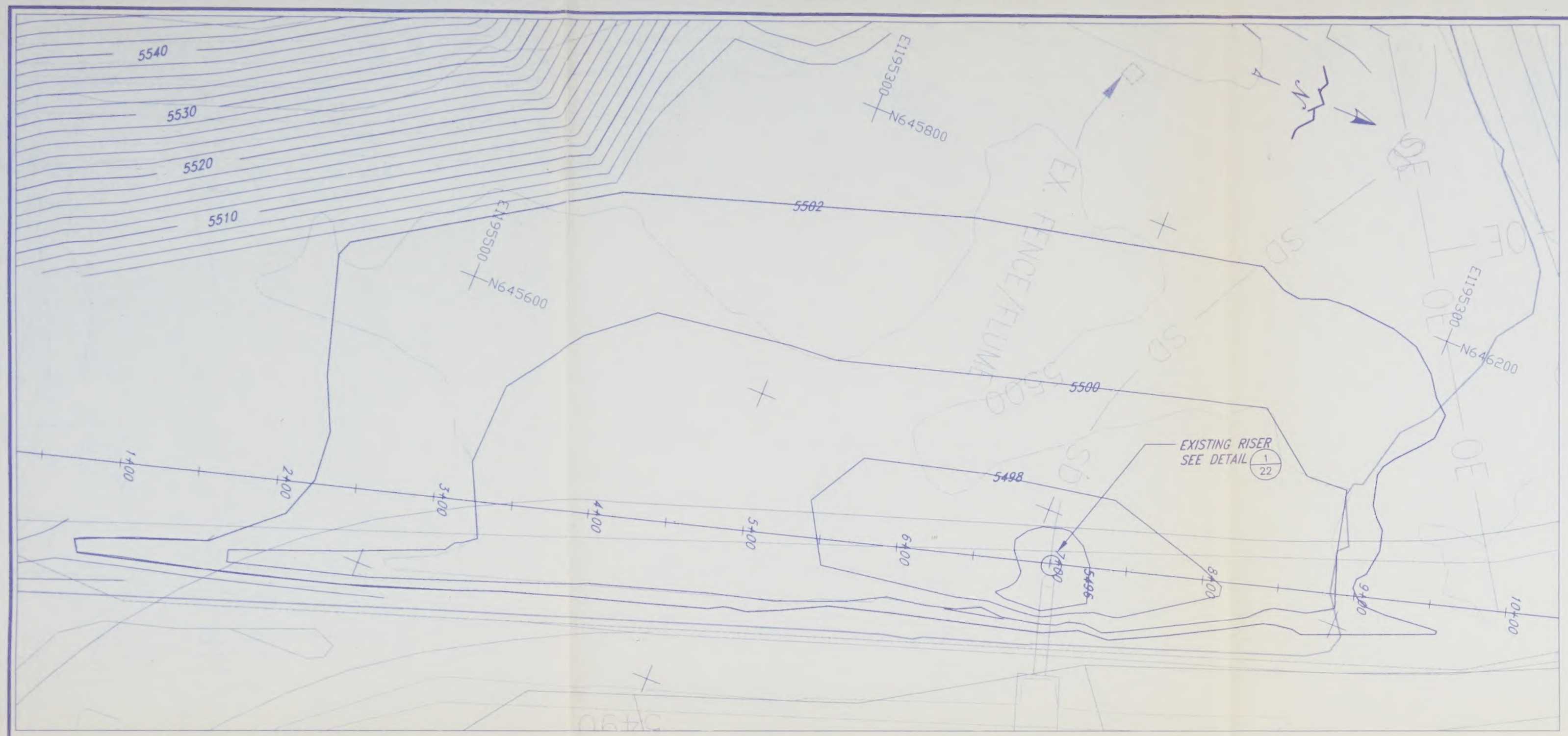
Brad Archibald

Brad Archibald, P.E.

cc:
James Johnston, BSB Public Works
Gary Keeler, BSB Public Works
Chuck Stilwell, ARCO
Ron Ziegler, ARCO
Robin Bullock, ARCO
Bill Duffy, PMH&S
Bob Fox, EPA
Neil Marsh, MDEQ
Jon Sesso, BSB Planning
Rick Larson, BSB Health
Eric Jacobsen, ARCO
Sandy Stash, ARCO
Dianne Smith, ARCO
Ron Bertram, EPA
Jim Harris, EPA

100% post-consumer paper & 100% vegetable based inks

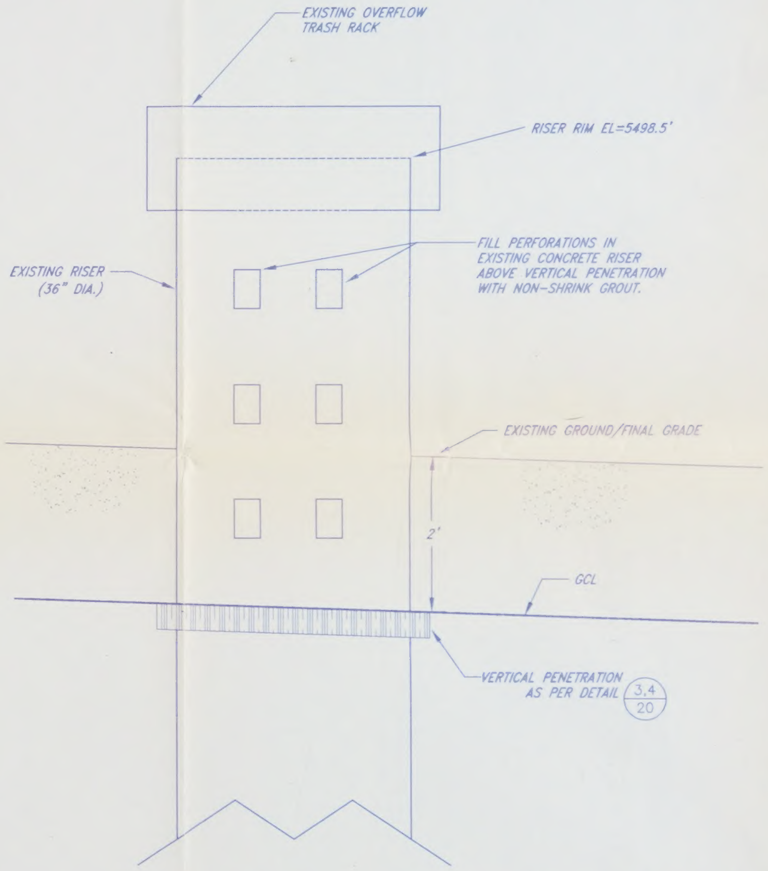

EXISTING OVERFLOW TRASH RACK
RISER RIM EL=5498.5'
FILL PERFORATIONS IN EXISTING CONCRETE RISER ABOVE VERTICAL PENETRATION WITH NON-SHRINK GROUT.
EXISTING GROUND/FINAL GRADE


5540
5530
5520
5510
E1195300
N645800
E1195500
N645600
5502
EX. FENCE/FLUME
SD
OE
E1195300
N646200
5500
EXISTING RISER
SEE DETAIL 1/22
5498
5496
N
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00

TIMBER BUTTE POND PLAN

1"=50'

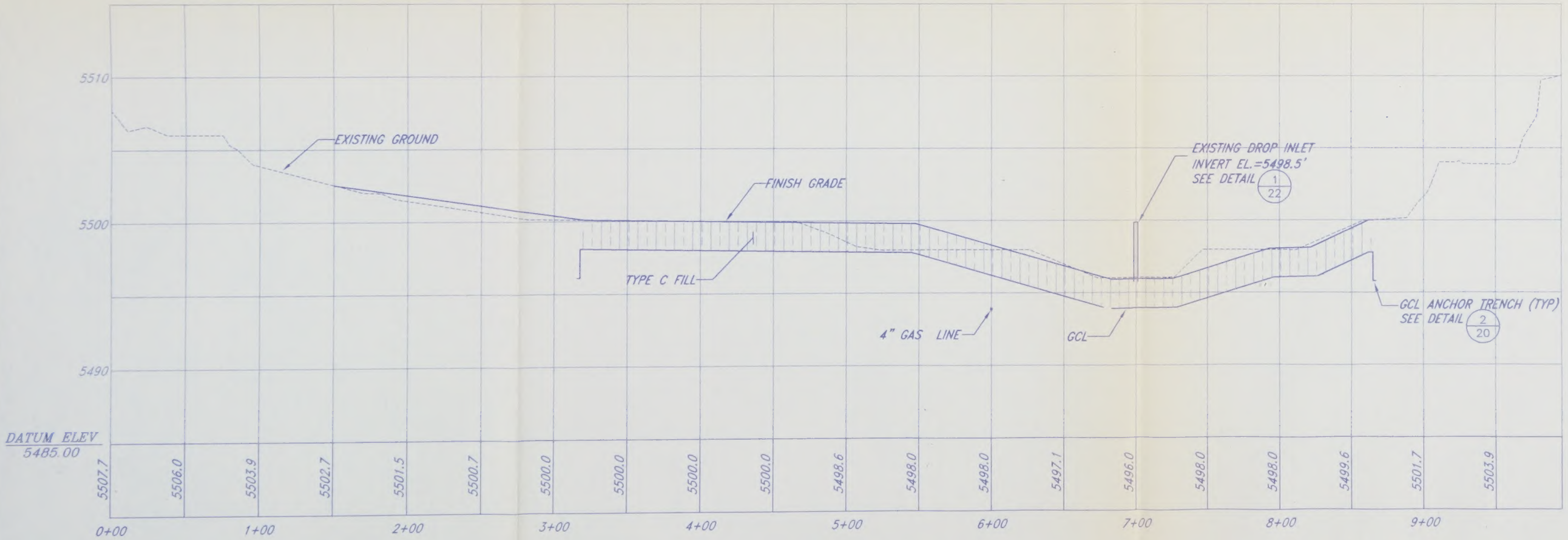
NOTE:
EXCAVATE TO GCL GRADE SHOWN ON THE CROSS SECTIONS (SHEET C-23). STOCKPILE CLEAN MATERIALS TO REPLACE OVER GCL. PLACE TAILINGS WITHIN CLARK TAILINGS FILL AREA. INSTALL GCL AND COVER WITH TYPE C FILL TO THE FINAL GRADE SHOWN.


EXISTING OVERFLOW TRASH RACK
RISER RIM EL=5498.5'
EXISTING RISER (36" DIA.)
FILL PERFORATIONS IN EXISTING CONCRETE RISER ABOVE VERTICAL PENETRATION WITH NON-SHRINK GROUT.
EXISTING GROUND/FINAL GRADE
2'
GCL
VERTICAL PENETRATION AS PER DETAIL 3,4/20

DETAIL 1/22

TIMBER BUTTE POND OUTLET WORKS SECTION

1"=1'


5510
5500
5490
EXISTING GROUND
FINISH GRADE
EXISTING DROP INLET INVERT EL.=5498.5' SEE DETAIL 1/22
TYPE C FILL
4" GAS LINE
GCL
GCL ANCHOR TRENCH (TYP) SEE DETAIL 2/20
DATUM ELEV 5485.00
5507.7
5506.0
5503.9
5502.7
5501.5
5500.7
5500.0
5500.0
5500.0
5500.0
5498.6
5498.0
5498.0
5497.1
5496.0
5498.0
5498.0
5499.6
5501.7
5503.9
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00

TIMBER BUTTE POND PROFILE

1"=50'

DRAFT
NOT FOR CONSTRUCTION
DATE: 2/14/97

NO.	BY	DATE	REVISION DESCRIPTION
0	BOA	2/14/97	ISSUED FOR REVIEW

LA0201

PJS DRAWN
PJS DESIGNED
BOA CHECKED
APPROVED
2/14/97 DATE
4502 PROJECT NO.

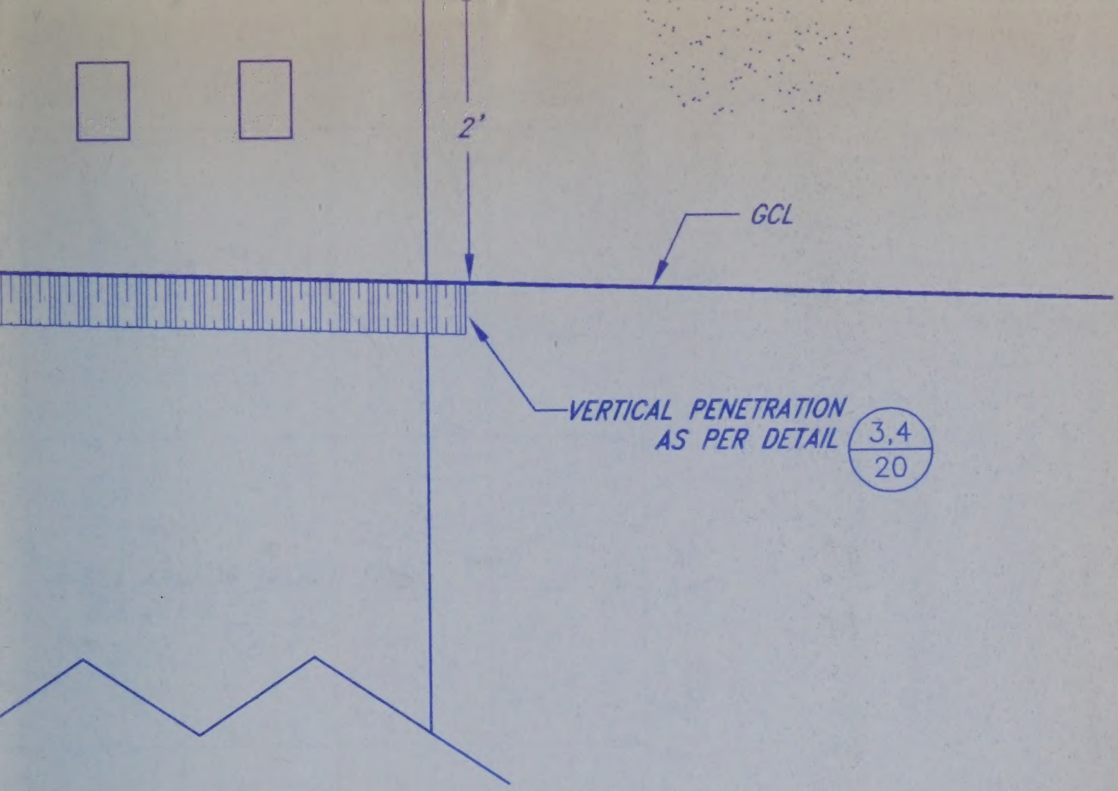
SCALE
HORIZ: 1"=50' VERT: 1"=5'
SCALE IN FEET
0 50' 100'

PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59702

ARCO
LAO/CLARK TAILINGS
DISPOSAL AREA

TIMBER BUTTE POND PLAN,
PROFILE & DETAIL

SHEET
C-22


2'
GCL
VERTICAL PENETRATION AS PER DETAIL 3,4/20

DETAIL 1/22

TTE POND OUTLET WORKS SECTION

1"=1'

DRAFT

NOT FOR CONSTRUCTION

DATE: 2/14/97

TIMBER BUTTE POND PLAN,
PROFILE & DETAIL

SHEET

C-22

O/9 Silver Bow Co.
Old Butte L.F. #20
Closure

Cu

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

Febraury 6, 1997

RECEIVED
FEB 10 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Ms. Sara Weinstock
U.S. Environmental Protection Agency
155 West Granite
Butte, Montana 59701

Dear Ms. Weinstock:

Enclosed are two copies of the *Final Draft, Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment*. Please keep one copy available for public review at your office. Please forward the other copy to CTEC, as they requested at last night's Butte-Silver Bow Council of Commissioners meeting.

In addition to these copies, I will forward one copy each to the Montana Tech Library and Ron Bertram at EPA's office in Helena.

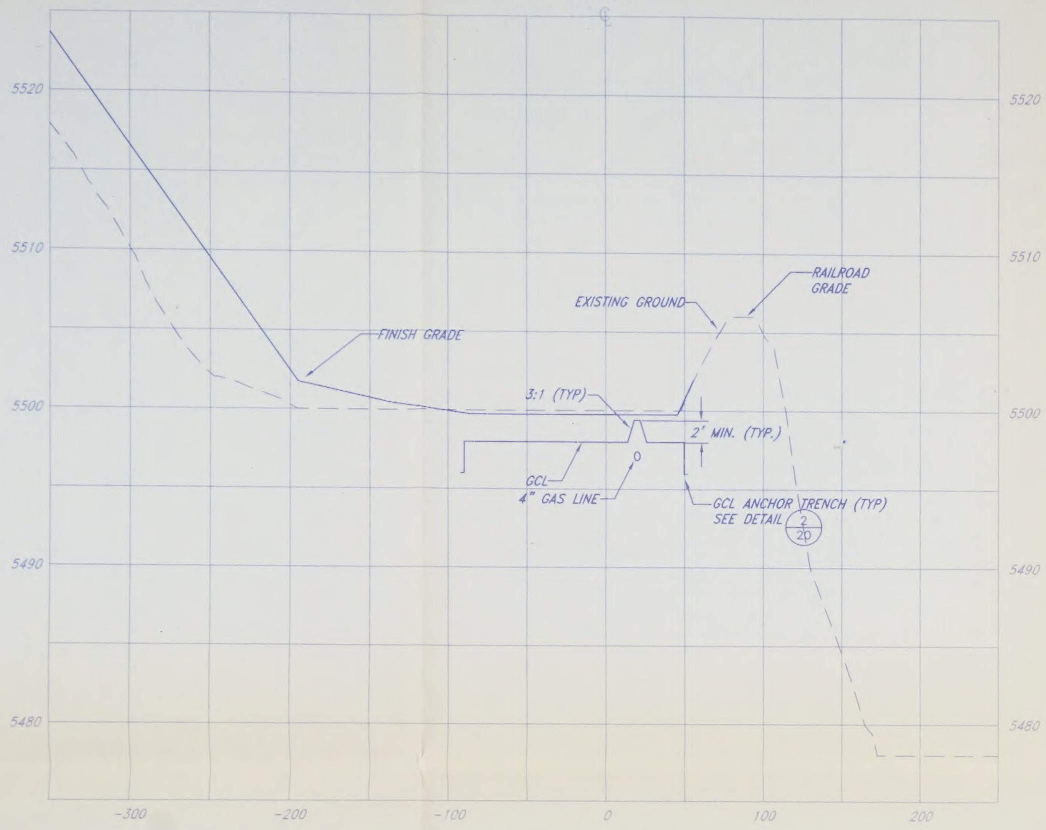
Sincerely,

Brad Archibald

Brad Archibald, P.E.
Senior Engineer

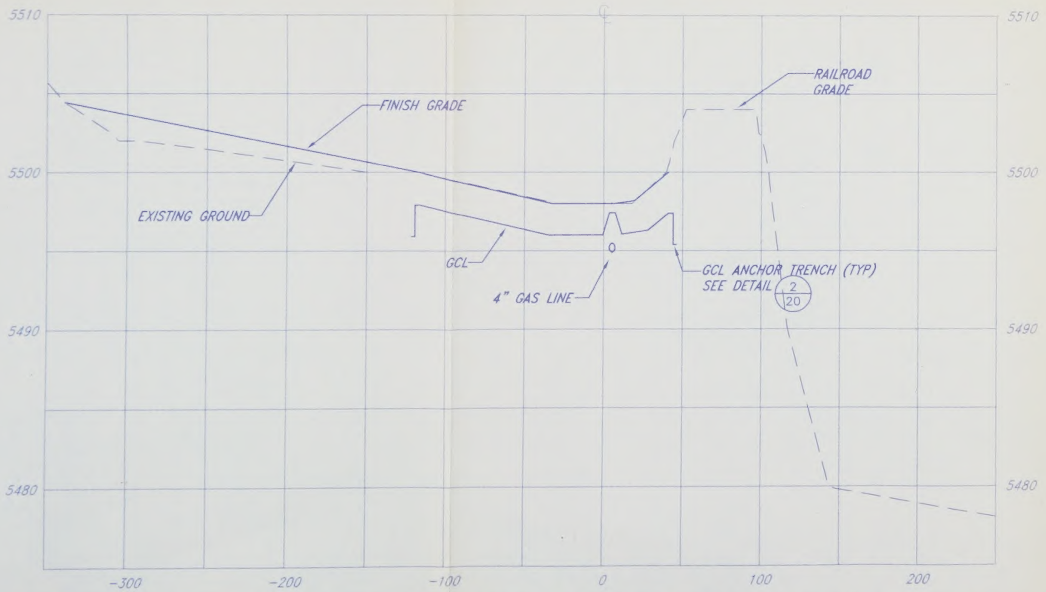
cc: James Johnston, BSB Public Works
Jon Sesso, BSB Planning
Pat Crowley, MDEQ
Chuck Stilwell, ARCO
Eric Jacobsen, ARCO
Ron Bertram, EPA

3+50



5520
5510
5500
5490
5480
RAILROAD GRADE
EXISTING GROUND
FINISH GRADE
3:1 (TYP)
2' MIN. (TYP.)
GCL
4" GAS LINE
GCL ANCHOR TRENCH (TYP)
SEE DETAIL 2/20
-300
-200
-100
0
100
200

5+50



5510
5500
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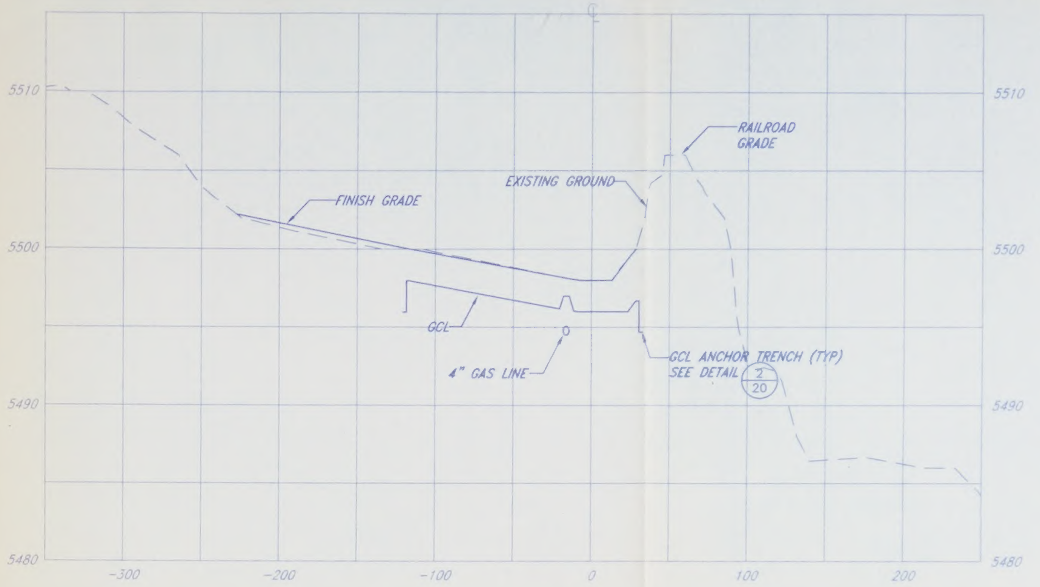
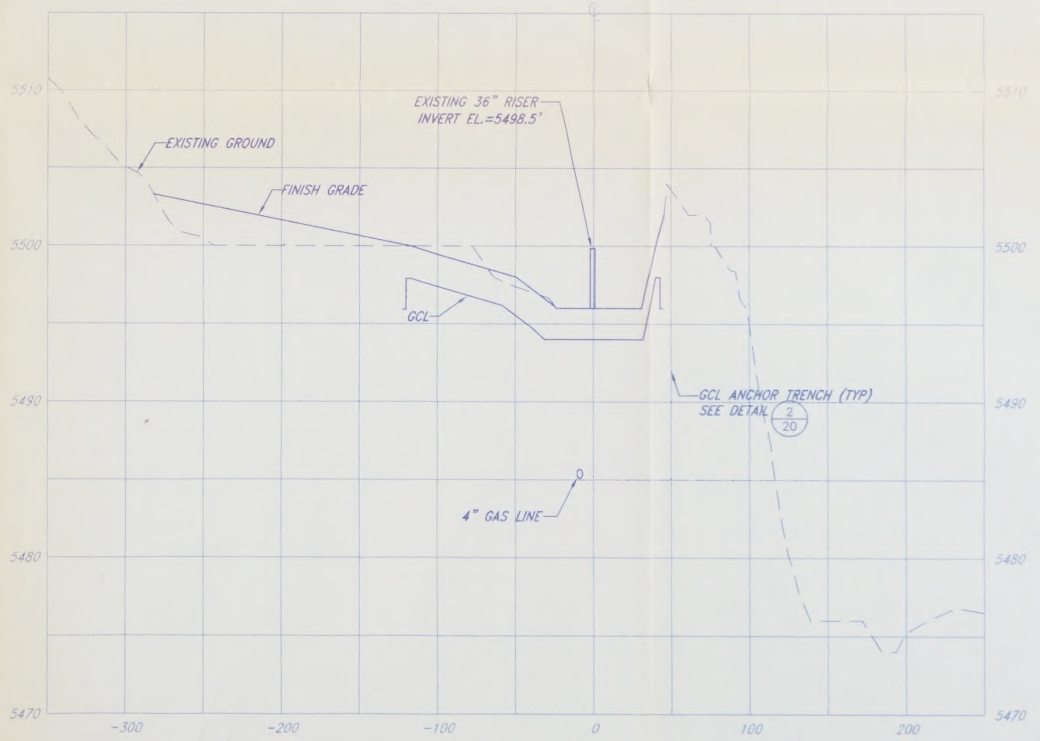
5480
RAILROAD GRADE
FINISH GRADE
EXISTING GROUND
GCL
4" GAS LINE
GCL ANCHOR TRENCH (TYP)
SEE DETAIL 2/20
-300
-200
-100
0
100
200

8+00



5510
5500
5490
5480
RAILROAD GRADE
EXISTING GROUND
FINISH GRADE
GCL
4" GAS LINE
GCL ANCHOR TRENCH (TYP)
SEE DETAIL 2/20
-300
-200
-100
0
100
200

7+00



5510
5500
5490
5480
5470
EXISTING 36" RISER
INVERT EL.=5498.5'
EXISTING GROUND
FINISH GRADE
GCL
GCL ANCHOR TRENCH (TYP)
SEE DETAIL 2/20
4" GAS LINE
-300
-200
-100
0
100
200

DRAFT
NOT FOR CONSTRUCTION
DATE: 2/14/97

NO.	BY	DATE	REVISION DESCRIPTION
0	BOA	2/14/97	ISSUED FOR REVIEW

PJS DRAWN
PJS DESIGNED
BOA CHECKED
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SCALE
HORIZ: 1"=50' VERT: 1"=5'
SCALE IN FEET
0 50' 100'

PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59702

ARCO
LAO/CLARK TAILINGS
DISPOSAL AREA

TIMBER BUTTE POND
CROSS SECTIONS

SHEET
C-23

LA0503

Silver Bow Co.
Old Butte L.F. #20
Closure

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

Febraury 6, 1997

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Sincerely,

Brad Archibald

Brad Archibald, P.E.
Senior Engineer

cc:
James Johnston, BSB Public Works
Jon Sesso, BSB Planning
Pat Crowley, MDEQ
Chuck Stilwell, ARCO
Eric Jacobsen, ARCO
Ron Bertram, EPA

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Old Butte #20 Silver Bow Co. Ck

2/5/97
Closure

(DRAFT) SITE UPDATE

Proposed Use of the Clark Tailings as a Disposal Site for Lower Area One Wastes

and

Closure of the Old Butte-Silver Bow Landfill and the Clark Tailings Area

February 1997

U.S. Environmental Protection Agency
Montana Department of Environmental Quality
Butte-Silver Bow County

The U.S. Environmental Protection Agency (EPA), the Montana Department of Environmental Quality (DEQ), and Butte-Silver Bow County (BSB) request public comment on proposed actions affecting the Lower Area One (LAO) Operable Unit of the Silver Bow Creek/Butte Area Superfund Site, the Old Butte-Silver Bow Landfill, and the Clark Tailings area. These proposed actions include:

- Corrective measures proposed to address ground water contamination and closure of the Old Silver Bow County Landfill and the Clark Tailings Area
- Use of the Clark Tailings area as a disposal site for the Lower Area One wastes, which include wastes from the Colorado Tailings and the Butte Reduction Works areas
- Construction of a haul road to the proposed Clark Tailings disposal site and the activities related to the transport of the LAO mining wastes to the proposed Landfill/Clark Tailings site
- Development of a proposed recreational complex to be constructed as part of Clark Tailings and Old Silver Bow County Landfill closure

A public hearing on these actions will be held **February 19, 1997, at 7:30 p.m.** before the Butte-Silver Bow Council of Commissioners at the Butte-Silver Bow County Courthouse, 155 West Granite Street, in the council chambers on the third floor.

Closure of the Old Butte-Silver Bow Landfill and Clark Tailings

The Old Butte-Silver Bow Landfill and Clark Tailings are located south of Beeftrail Road and west of Montana Street, north of Timber Butte (see Figure 1). Both are to be closed for the long-term management of wastes and for the protection of the local public health and the environment. The Old Landfill and Clark Tailings will be closed as a consolidated waste management unit. Closure of the Old Landfill and Clark Tailings site is under jurisdiction of the DEQ Solid Waste Program and applicable Resource Conservation and Recovery Act (RCRA), Montana Solid Waste Management Act (MSWMA), and applicable Montana solid waste regulations at Title 17, Chapter 50 of the Administrative Rules of Montana (ARM).

An acceptable solid waste closure and corrective measures plan for the Old Landfill and the Clark Tailings is now before DEQ. In this plan, BSB County has identified a preferred alternative for addressing site conditions. The preferred alternative for the Old Landfill consists of completing and revegetating the landfill cover in accordance with applicable regulations and passively venting the landfill gas. Construction activities at the Old Landfill are scheduled to take place in 1997. The preferred alternative for the Clark Tailings includes placing the LAO materials and installing a low permeability soils cap with a revegetated surface, in accordance with applicable regulations, designed to minimize infiltration and protect ground water. Construction activities at the Clark Tailings will occur during 1997 and 1998. The preferred alternative for both Landfill and Clark Tailings includes a long-term ground water monitoring program and a comprehensive land-use and ground water management program. Development of the recreation complex would occur in conjunction with the LAO/Clark Tailings repository construction.

Use of the Clark Tailings as a Disposal Site for Lower Area One Wastes

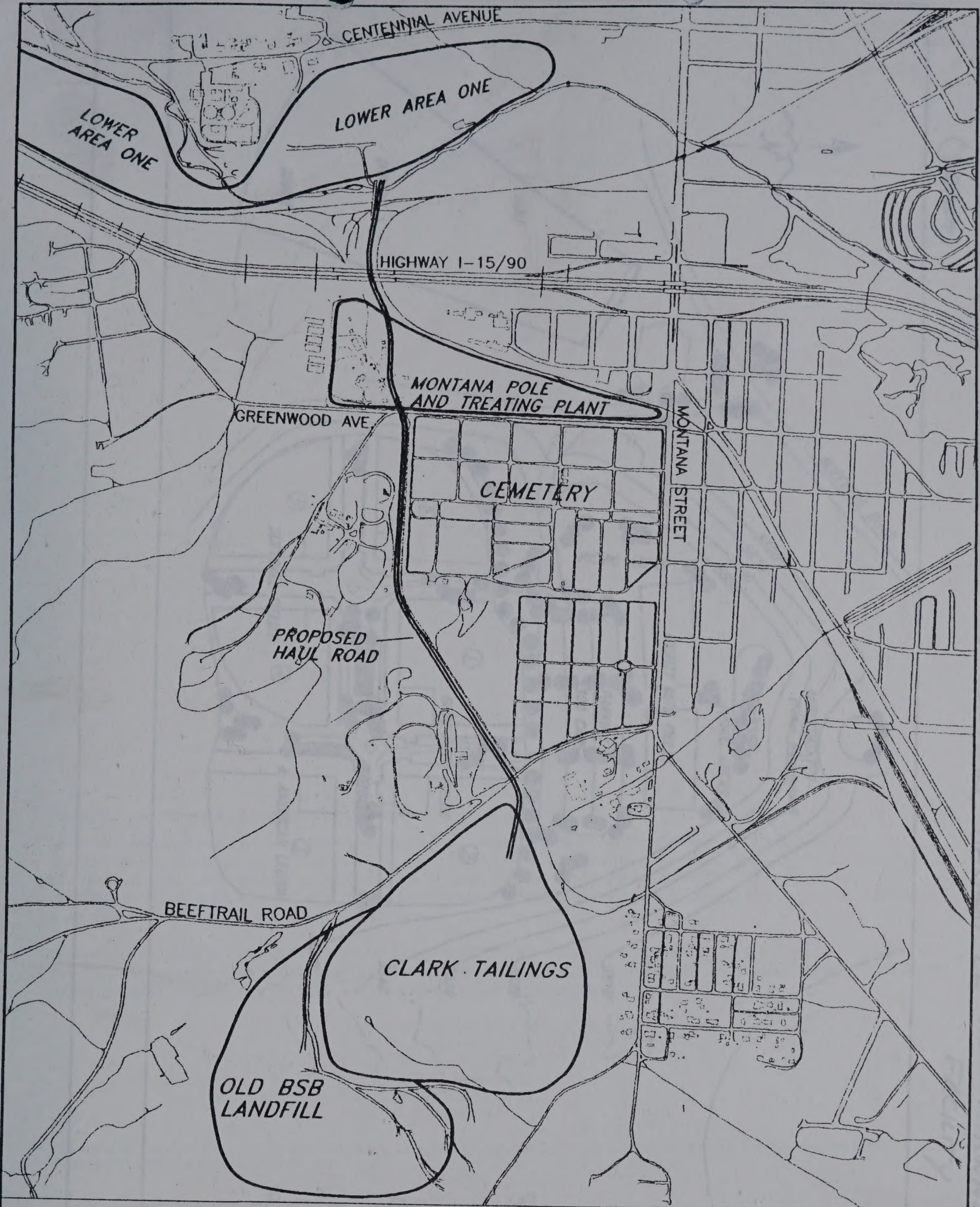
The proposed action involves a change in the current EPA-ordered action for Lower Area One (LAO). In December 1991, EPA selected the Opportunity Ponds as the disposal area for waste removed from LAO. However, because an acceptable solid waste closure and corrective measures plan for the Old Butte-Silver Bow County Landfill and the Clark Tailings is now before DEQ (the regulatory agency in charge of that action), EPA is now proposing to designate the Landfill/Clark Tailings area as the disposal site for the LAO wastes.

Mine waste material from LAO would be transported from LAO to the Clark Tailings site via 35- to 50-ton haul trucks. From LAO, the proposed haul road would cross the Montana Western railroad track, transect the Montana Pole and Treating Plant Superfund Site, cross Greenwood Avenue, traverse the old rail grade between Greenwood Avenue and Beeftrail Road, and cross Beeftrail Road to the Clark Tailings site (Figure 1).

The only interaction between the public and the haul road would be the crossings at Greenwood Avenue and Beeftrail Road. Presently, the excavation/hauling of LAO materials is scheduled to occur from March through November 1997 and would resume in this same time period, if necessary, in 1998. Continuous hauling would occur up to 10 hours per day, 6 days per week. During peak operations, approximately one haul truck every 90 seconds would be crossing public roads. Traffic at both public road crossings will be controlled by flagmen to ensure safety.

The relocated LAO waste materials will be shaped, compacted, and covered with a soil cap which will isolate all existing and relocated materials from the environment. The cap will be designed in accordance with State solid waste requirements and will address possible groundwater contamination issues. The constructed repository would be graded to match existing contours in the area and would also serve as the site for a proposed recreational complex. The complex would include ballfields, concession and restroom facilities, picnic areas, and other amenities. A more detailed description of the recreational complex will be provided at the February 19, 1997, public hearing. A conceptual design of the recreational complex as shown on Figure 2.

(EPA FACT SHEET) FIGURE [illegible] : HAUL ROUTE DRAFT

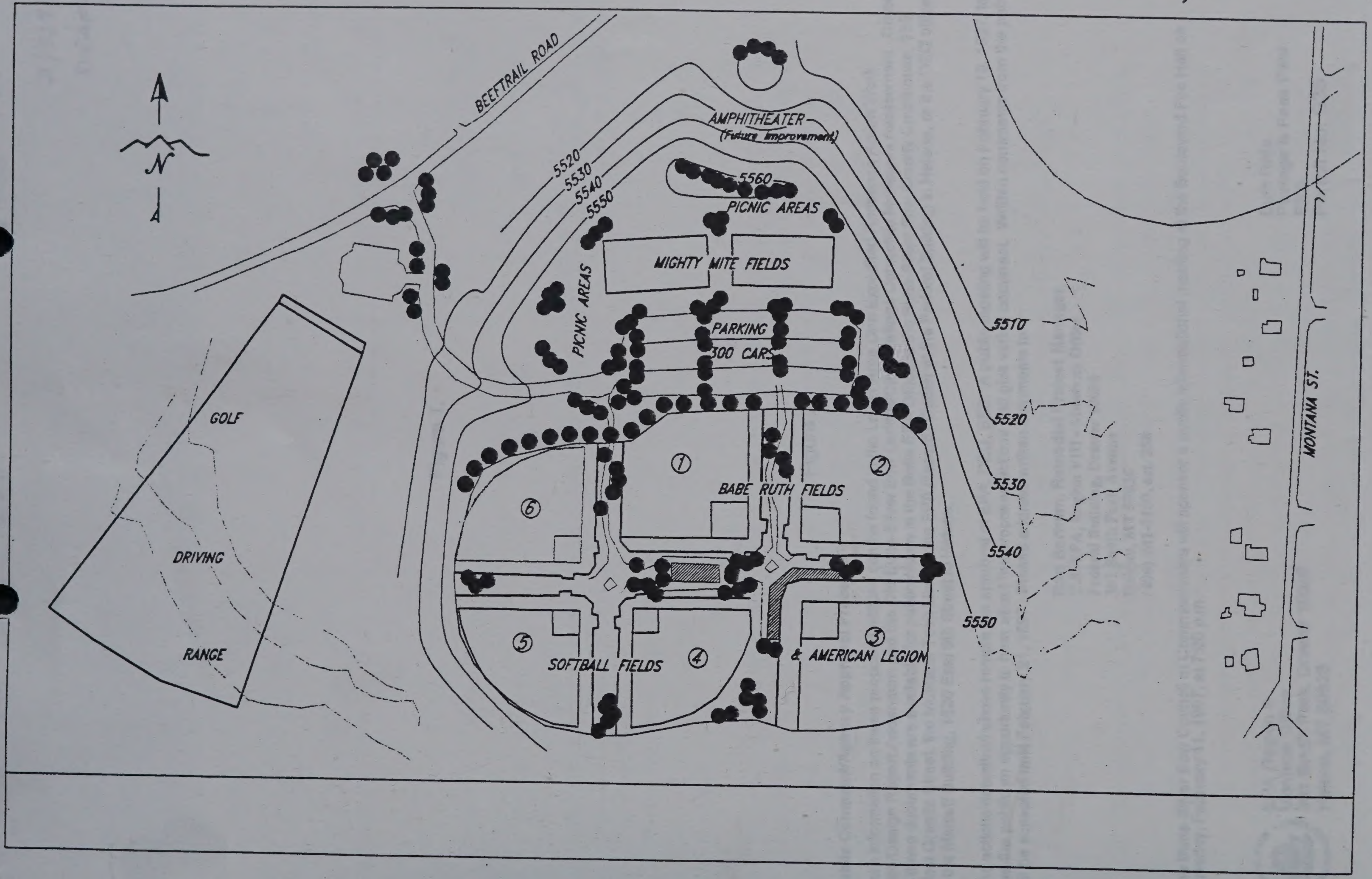

CENTENNIAL AVENUE
LOWER AREA ONE
LOWER AREA ONE
HIGHWAY I-15/90
MONTANA POLE AND TREATING PLANT
GREENWOOD AVE.
MONTANA STREET
CEMETERY
PROPOSED HAUL ROAD
BEEFTRAIL ROAD
CLARK TAILINGS
OLD BSB LANDFILL

PROPOSED HAUL ROAD: LAO TO CLARK TAILINGS

C:/BUTTEGIS/BUTTE.DWG

(EPA FACT SHEET)
(DRAFT)

FIGURE 2: CONCEPTUAL DESIGN OF RECREATIONAL FACILITY


N
BEEFTRAIL ROAD
AMPHITHEATER
(Future Improvement)
5520
5530
5540
5550
5560
PICNIC AREAS
MIGHTY MITE FIELDS
PICNIC AREAS
PARKING
300 CARS
5510
5520
5530
5540
5550
GOLF
DRIVING
RANGE
①
②
BABE RUTH FIELDS
⑥
⑤
SOFTBALL FIELDS
④
③
& AMERICAN LEGION
MONTANA ST.

2/5/97
DRAFT

Figure 1.

Figure 2.

Public Comment/Agency Approval Process

More information on these proposed actions can be found in the Lower Area One Expedited Response Action Work Plan/Design Report Addendum and the Old Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment. Copies of these documents are available for public review in the Butte EPA Office at the Butte-Silver Bow County Courthouse, 155 West Granite Street, the Montana Tech Library, the EPA Records Center at the Federal Building in Helena, or the DEQ offices in the Metcalf Building, 1520 East 6th Street in Helena.

The actions described above require the approval of EPA, DEQ, BSB. A public meeting will be held on February 19, 1997, to give the public an opportunity to hear about the proposed actions and give verbal comment. Written comments from the public will be accepted until February 21, 1997. Please address written comments to:

Ron Bertram, Remedial Project Manager
U.S. EPA, Region VIII - Montana Office
Federal Building, Drawer 10096
301 South Park Avenue
Helena, MT 59626
(406) 441-1150, ext. 258

The Butte-Silver Bow Council of Commissioners will sponsor a public informational meeting at the Boulevard Fire Hall on Tuesday, February 11, 1997, at 7:00 p.m.

EPA Region 8
Montana Office
301 South Park, Drawer 10096
Helena, MT 59626

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Old Butte L.F. #20 Cu
Closure
Silver Bow Co.

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TECHNICAL SERVICES, INC.
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RECEIVED
JAN 30 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

January 29, 1997

F. Patrick Crowley
Solid Waste Regulatory Lead
Solid Waste Program, Permitting and Compliance Division
Montana Department of Environmental Quality
P.O. Box 200901
Helena, Montana 59620-0901

Dear Pat:

This letter is Butte-Silver Bow's and ARCO's response to your January 16, 1997 letter to Sandra Stash and Jack Lynch and your January 23, 1997 memorandum to Brad Archibald regarding the corrective measures assessment and closure of the Old Butte-Silver Bow Landfill and the Clark Tailings. We provide general responses below, as we discussed during our January 22 meeting in Helena. Detailed responses will be incorporated into revisions to the corrective measures assessment report, which will be issued soon. We feel we can resolve these few remaining issues and proceed to the public meeting and present the preferred alternative.

In response to your January 16, 1997 letter:

1. A new well, CLK-2, has been installed near the northeastern corner of the Clark Tailings. We intend to sample this new well this week.

2. We analyzed two additional composite samples of the LAO clayey materials via EPA Method 1312. While all levels were significantly below TCLP standards, these samples contained concentrations of some leachable metals slightly above groundwater protection standards. A significant fraction of the metals are most likely due to dissolved metals present above groundwater protection standards in the interstitial water from these saturated samples. Nonetheless, the majority of the data show that the materials will not exceed these standards. We do not agree that groundwater protection standards are an appropriate standard for this issue. This is based primarily on the fact that the small amount of precipitation that may infiltrate through the barrier layer will be subjected to higher metals content and longer retention time in the underlying tailings. In other words, the metals potentially leached from the infiltration barrier layer would be insignificant. Therefore, based on our discussions with you on January 22, we intend to use the material either by itself or mixed with other capping materials, to the extent that it is available and can be separated from the tailings. We would like to reserve the right to use the LAO clayey

material for the infiltration barrier layer upon resolving remaining agency concerns if deemed necessary at a later time.

3. No response is necessary.

4. No response is necessary.

5. We agree that each of the materials tested can meet the specified hydraulic conductivity. We will utilize compaction equipment capable of ensuring uniform compaction of the infiltration barrier materials. Low-ground pressure tracked vehicles will not be used for compaction purposes.

6. We maintain that the single point of compliance would satisfy regulatory requirements and be protective of human health and the environment. However, you have definitively concluded that two points of compliance are necessary at this site. Therefore, a groundwater monitoring plan for each of the points of compliance will be presented in the updated corrective measures assessment report. As we discussed on January 22, 1997, the plan will not include metals monitoring at the landfill point of compliance and will not include organics monitoring at the Clark Tailings point of compliance.

In response to your January 23, 1997 memorandum regarding the *Final Draft, Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment*:

1. We agree with this statement that placement of the LAO materials at the Clark Tailings would constitute post-October 9, 1991 waste placement under solid waste regulations. If the LAO materials are not imported, the type of cap required over the Clark Tailings will be re-addressed.

2. Fine-grained materials may infiltrate a portion of the six-inch layer included in the preferred alternative. For the application being proposed, two to three inches of coarse-grained material would serve adequately as a capillary break. This has been ARCO's experience with mine waste reclamation in this area. In addition, Stormont, Morris , and Finley ("Capillary Barriers for Covering Mine Wastes, " *Tailings and Mine Waste '96*) state that the thickness of the coarse layer (capillary break) is of little significance to the performance of the cover soil layer. The design included in the preferred alternative was based on the integrity of a portion of the capillary break possibly being sacrificed to fines infiltration. To address your concerns, ARCO agrees to a new design which includes a three-inch capillary break layer overlaid by a geotextile filter fabric. The final design will be included in the construction drawings and technical specifications presented to you for review and approval.

3. As discussed above, the updated corrective measures assessment will include a groundwater monitoring plan for two points of compliance.

4. Diversion ditches that cross tailings and are not graded steeply enough to ensure water will not pond and infiltrate within the diversion will be lined with a low permeability geosynthetic liner or a geomembrane instead of the 18-inches of low permeability soils and a capillary break.

5. The amphitheater will be graded to be self-draining.

6. As we discussed on January 22, recent findings at the Clark Tailings have led us to conclude that the Timber Butte Sedimentation Basin must be lined and the liner sealed to the riser. The updated corrective measures assessment report and construction drawings will reflect this.

7. If Alternative 8 does not correct VOC groundwater contamination, BSB will re-address the issue and implement additional corrective measures if appropriate. Based on the local hydrogeology and travel distances to the points of compliance, we feel that two years is not long enough to determine if the corrective measures implemented are effective, as we discussed on January 22. Our calculations to support this claim will be included in the updated assessment of corrective measures. The groundwater monitoring plan in the updated report will include quarterly monitoring for VOCs (as the recently submitted version of the report does).

   The same calculations and estimated time to reach compliance will be provided for the Clark Tailings portion of the site, also.

8. The reported tranmissivity is from a regional study and was the closest reported transmissivity datum available. It apparently was measured in the Blacktail Creek aquifer and is not representative of the Old Landfill/Clark Tailings site. Based on the local setting, the transmissivity at the site is estimated be much less. Details regarding this will be included in the travel time calculations discussed above.

   We will add the approximate location of tailings to the cross-section. Based on the well logs, tailings are not in contact with groundwater through this section. Available information regarding the location of tailings with respect to groundwater will be summarized and presented in the revisions to the corrective measures assessment report.

9. We will present a clear time table for improving groundwater quality and ultimately achieving groundwater protection standards, based on our calculations discussed above.

10. The referenced report is the Stage II report by SRM, which was approved by MDEQ. The reference will be clarified to reflect this.

11. We will acquire an MPDES Storm Water Discharge permit for construction activities associated with the placement of the LAO materials and capping of the site.

12. The phrasing of the report will be clarified so as not to imply that construction and demolition debris are not Group II wastes.

13. We do not know that there are not organics present in CLK-1 or CLK-2 since they have not been monitored for these parameters. We believe that there are most likely no organics in excess of groundwater protection standards at these locations based on the findings of the geoprobe investigation and downgradient well sampling. The report will be clarified to reflect this.

14. BMPs will be employed during the interim (during construction) to minimize impacts to surface water. No other interim measures are considered to be necessary at this time. The discussion of the preferred alternative will be updated to reflect this.

15. EPA has not amended the order. They have verbally agreed to the concept of moving the LAO materials to the Clark Tailings pending approval by the Solid Waste Program. The order will be amended appropriately after all parties reach a final agreement.

16. We agree with this statement; the report will be updated to clarify issue. It will not change the statistical analysis of the data, since none of the data were detected below the PQL but not quantified (with a J or E qualifier).

17. No response is necessary.

18. While there may have been some short-term impacts to Grove Gulch during large runoff events (such as you witnessed last February), the presence of the Timber Butte Sedimentation helps to protect Grove Gulch. The data available from Grove Gulch downgradient of the site do not indicate that there are any chronic impacts from the Clark Tailings. Implementing the preferred alternative (including revegetation, drainage improvements, etc.) should help minimize any future short-term and long-term impacts.

19. The report will be updated to clarify that there is an apparent plume, not just a localized phenomenon.

As we discussed at our meeting, the construction drawings will be updated to reflect the extent of surficial tailings to be consolidated with the majority of the tailings, based on

the test pits recently installed at the site. Also, the language in the corrective measures report will be clarified to reflect that the point of compliance for the Clark Tailings portion of the site will be the facility property boundary no more than 150 meters downgradient from the unit.

We believe that this response reflects the discussions during our January 22 meeting, and the agreements we reached during that meeting. With this information, we hope that you are able to assure EPA's representatives that we are ready to proceed to the public meeting phase of the corrective measures process. If you have any questions, please give me a call. In the meantime, we will prepare the revisions to the corrective measures assessment discussed above and forward those to you as soon as possible.

Sincerely,

Brad Archibald

Brad Archibald, P.E.
Senior Engineer

cc:
James Johnston, BSB Public Works
Gary Keeler, BSB Public Works
Chuck Stilwell, ARCO
Ron Ziegler, ARCO
Robin Bullock, ARCO
Bill Duffy, PMH&S
Bob Fox, EPA
Neil Marsh, MDEQ
Jon Sesso, BSB Planning
Rick Larson, BSB Health
Eric Jacobsen, ARCO
Sandy Stash, ARCO
Dianne Smith, ARCO
Ron Bertram, EPA
Jim Harris, EPA

Old Butte L.F. #20
Closure
Silver Bow Co.

Lower Area One/Clark Tailings
January 28, 1997 Meeting

AGENDA

- Clark Tailings Repository Approval
- Montana Pole Coordination
- LAO Approval Process
- Schedule
- Land Access
    - Status Update
    - Actions Required

Lower Area One/Clark Tailings
SCHEDULE

Action	Schedule	Complete
Clark Tailings		
• Corrective Measures Assessment	January 15	✓
• Letter on Remaining Issues (MDEQ/SWB)	January 21/24	✓
• Letter to Address Remaining Issues (BSB/ARCO)	January 28	✓
• Notice of Public Meeting (BSB/EPA)	January 29	
• Public Meeting - see below (BSB/EPA)	February ~~10~~ [illegible] 11	
• Letter Approving Repository Design/CMA (MDEQ/SWB)	February ~~14~~ 17	
MPTP Coordination		
• Discussion of Issues (MDEQ/ARCO)	January 15-23	✓
• Letter Providing ACCI Protection from Liability (ARCO)	January 24	✓
• Letter Confirming Technical Issues Addressed (ARCO)	January 28	
• Other Issues Resolved with ACCI (ARCO)	February 10	
LAO/EPA Approval		
• LAO Design Report/Work Plan Addendum (ARCO)	January 29	
• Review of Addendum (EPA)	February 6	
• Public Meeting (BSB/EPA)	February 10	
• Public Review Period (complete 10 days after public meeting)	Jan 29 - Feb 20	
• Letter Approving of Design Report/Work Plan Add. (EPA)	February 21	
• Action Memo Revision ? (EPA)	?	
Land Access		
• Inland Properties (ARCO)	December 1996	✓
• Hollow Construction (ARCO)	February 3	
• BN Railroad (ARCO)	February 3	
• Montana Western Railroad	?	
• Oass (MDEQ/EPA)	?	
Construction		
• Preliminary Mob./ Haul Road Construction (outside MPTP)	February 17	
• Haul Road Through MPTP	February 24	
• Excavation/Haul Commences	March 1	

Silver Bow County

C4

Old Butte L.F #20
Closure Pla

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

January 24, 1997

RECEIVED
JAN ~~24~~ 27 1997
FPC
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

F. Patrick Crowley
Solid Waste Regulatory Lead
Montana Department of Environmental Quality
1520 East Sixth Ave.
P.O. Box 200901
Helena, Montana 59620-0901

RE: Clark Tailings Submittals

Dear Pat:

Enclosed are two copies of the draft construction drawings, technical specifications, and construction quality assurance plan for the Clark Tailings for your review. You will notice a few of the items we discussed on January 22, and included in your January 23, 1997 memo, are not addressed in these documents. We will incorporate those items in the final version of these documents.

Sincerely,

Brad Archibald, P.E.

Enclosures

cc:
James Johnston, BSB Public Works
Gary Keeler, BSB Public Works
Chuck Stilwell, ARCO
Ron Ziegler, ARCO
Robin Bullock, ARCO
Bill Duffy, PMH&S
Bob Fox, EPA
Neil Marsh, MDEQ
Jon Sesso, BSB Planning
Rick Larson, BSB Health
Eric Jacobsen, ARCO
Sandy Stash, ARCO
Dianne Smith, ARCO
Ron Bertram, EPA
Jim Harris, EPA

100% post-consumer paper & 100% vegetable based inks

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: DATE: 1/24/97

1. Pat Crowley

2.

3.

☐ Approval
☐ Note and Return
☐ Prepare reply
☐ As requested
☐ Comment
☐ Note and File
☐ Signature
☒ For your information
☐ Necessary Action
☐ Investigate
☐ See Me
☒ Per Conversation

REMARKS: Mine waste containme
& repository information

FROM: Judy [illegible]

RECEIVED

JAN 27 1997

MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

MINE WASTE CONTAINMENT

Things to Know/Consider

Objectives: To limit the movement of water and air into or out of the waste to prevent future acid rock drainage (ARD).

To maximize the life of the containment system, ideally with as little O&M as possible.

Effectively assess the success of the containment system.

General Information - Influencing Factors on Remediation Alternatives

Geochemistry of Waste

a) What are the relative concentrations of various metals, especially arsenic, and what is the acid potential of the material? If you have high levels of arsenic (i.e., Josyln Street tailings) you may not want to amend your waste with lime, as this has the potential to mobilize the arsenic.

b) Acid Base Accounting (ABA). This is a measurement of the acid producing potential of the material (waste rock and/or tailings). Remember the uncertainty factor of this analytical method can be high. Please see the section on ABA.

Repository Location

Local climate (precipitation/evapotranspiration) - situations that may lead to ARD:
- recharge events when plants are dormant and/or insufficient rooting necessary to store excess moisture.
- significant rain on snow events?
- frost depth

Remote, industrial, residential
Floodplain
Local geology - bedrock
Depth to groundwater (is the local groundwater a potential drinking water source?)
Distance to surface water, wetlands, ponds, etc
Native vegetation - trees?

Repository Design

Do solid waste and hazardous waste regulations/guidelines apply and are they realistic? ARARS/ERCLS may work better because they can have design criteria, whereas the solid waste regs don't.

Type of waste
Amended/unamended - this is critical to the overall repository design and monitoring
Top - flat, sloped, run-on control, run-off control
Side slopes - gradient, total length, swales, gabions,
Leachate collection system - purpose?
Liners - top, bottom, between layers, composition
Thickness of cover soil, barrier layer(s), drainage layer(s)
Access - motor heads and animals
Compaction specifications
If amended: amendment material, method of incorporation of amendment, depth of amendment material within the waste pile. Please see the section on amendment material information.
Infiltration barriers
Model saturated flow, if possible. Remember a model is only as good as its input.

Topsoil

Please see that attachment titled "Requirements For Soil"
Quantity and quality - source/cost/shipping costs
SAR
Amended not amended
Thickness
Particle size distribution - For example, data from wind tunnel testing at DOE-Hanford has shown that as little as 15% pea gravel size particles in topsoil will successfully limit wind erosion. And, if a drainage layer is included without a barrier between it and the coversoil, the coversoil may pipe and effectively eliminate the purpose of the drainage layer (i.e., the Carbonate repository).

Vegetation

Type, diversity, long term success
Tacifier, mulch
Root depth - grasses, shrubs, trees
Amendment effect on plant performance - pH 9-11 seedlings negatively impacted by phytotoxic effect of OH and by unavailability of P due to high pH. Roots have been shown to follow localized horizons with pH > 5.5. Ca(OH)2 and CaCO3 resulted in increased vegetative cover compared to just Ca(OH)2. If just CaCO3 is used for the amendment material this wont' raise the pH above 8.5.

Weeds

Monitoring - is dependent upon the type of repository you build and the location characteristics

Settling monuments - # and location
Leachate collection system - what are you going to do if you have contaminated leachate?
Is anyone REALLY going to dig up the waste and start over? Do it right the first time or don't to it at all.
Vegetative success
Erosion control - top, side slopes, run-on, run-off, natural and human/animal induced
Monitoring wells - up-gradient, downgradient
Stability
Infiltration - neutron probes
Pore water - lysimeters
Long term maintenance?

ACID BASE ACCOUNTING
GENERAL INFORMATION

Acid base accounting is a laboratory method used to measure the potential of future acid generation from pyrite bearing material. Basically it is the neutralization potential (NP) minus the acid potential (AP):

$$ABA = NP - AP$$

A negative number indicates that you have an acid producer. The number can vary dramatically and there really is no such thing as a "low" or "moderate" acid producer. Acid potential is active acidity plus potential acidity (AA + PA = AP).

SMP - single buffer method - is a procedure used to determine the amount of active acidity in a soil matrix. It is an acronym of 3 peoples last names. Results are reported in tons $CaCO_3$.

Amendment rate are characterized by the amount of lime ($CaCO_3$) required to neutralize the waste material. Tons per $CaCO_3$ per 1000 tons of waste material. (1 acre on land 6" deep weighs approximately 1,000 tons).

Calcium Carbonate Equivalency (CCE) is a measure of a material's acid neutralization capability compared to pure $CaCO_3$. Pure $CaCO_3$ has a CCE of 100%. If material is subject to weathering the CCE can decrease. A CCE 90% confidence interval is desired for neutralization.

Uncertainty arises from:

> In acid base accounting it is assumed that pyrite and marcasite are responsible for acid generation, but there often are other minerals present that can affect ABA. For example, iron monosulphides - pyrrhotite ($Fe_{1-x}S$), is soluble in hydrochloric acid; but the Sobek analytical method counts the extractable sulfur as nonacid. Siderite ($FeCO_3$) can be considered as contributing to neutralization potential in the laboratory, but offers none in the field.
>
> Can the abundance of pyrite in a sample be accurately measured in the laboratory?
>
> Two equally scientifically sound methods (Sobek and ASTM) can yield different results of the same material.

Sample size and number. There is a tremendous amount of variability within a given waste pile, so more samples are better. However, be reasonable. If possible, sample the entire pile (i.e., channel samples).

AMENDMENT INFORMATION

Consider:

- Material cost
- Shipping cost
- Incorporation cost
- Partially amending waste - i.e., the top three feet
- Fully amended waste
- Added volume due to amendment material effects size of repository
- Amendment material % moisture, CCE, and metal content
- Particle size of waste rock & amendment material
- Water content - additional weight increasing shipping costs, effects on compaction specifications and decrease in CCE.
- Particle size - amendments used to neutralize acidic mine waste should have a particle size Sufficient to pass a 60 mesh sieve.

Neutralizing Materials

(listed in order of relative cost and CCE is based on particle size > 60 mesh sieve)

Calcium Oxide (CaO)
Continental Lime Company, Townsend Montana
111 - 179% CCE
Good performance of vegetation

Calcium Carbonate (CaCO3)
Montana Limestone Company, Bridger, Montana
96% CCE

Cement kiln dust (Quicklime Processing Kiln Waste)
85% (CCE)
CaCO3, Ca(OH)2 and CaO
very fine particle size
by-product from production of portland cement
performance of vegetation is not as good as above

Sugar beet Process Waste (CaCO3)
80% CCE

Weathered Flux Bar Magnesium Processing Waste (from manufacture of magnesium metal from dolomite)
97% CCE, 52% CCE (corrected for 46% of material not passing through 60 mesh sieve
Northwest Alloys, Addy Washington (May be willing to ship to Montana state border for free)

Pit Run Dical Slag Magnesium Processing Waste
106% CCE

Cement Plan Kiln Waste
74-85% CCE
Holnam Inc., Three Forks, Montana

Fly ash
59.5% CCE
very fine particle size

Phosphate rock
good amendment material for lead (binds with the lead and is very insoluable $PbPO_4$), available & low cost

LINERS

Geomembrane

polyvinyl chloride (PVC), polyethylene (PE) and polyporpylene (PP) polymers
installation costs: $.30 to .80/ ft2

Compacted clay liners (CCL)

formed from compaction of clays or bentonite amended silts and sands
installation costs: non-amended $9.50 to 13.00/yd3

Geosynthetic clay liners (GCL) - see attached information

formed by fixing bentonite granules between two geotextiles or bonding it to the face of a geomembrane
Installation costs: $.50 to .65/ft2

They all leak. The predicted leakage rate through a single 1 cm2 hole in the geomembrane:

Type	Leakage Rate
CCL (1' thick) only	92 gallons/acre/day
Geomembrane alone	3300 gallons/day
Geomembrane + CCL	0.15 gallons/day
GCL	0.045 gallons/day

Things to consider:

Chemical compatibility - organics
QA/QC for installation - think about 1 hole, seams, ambient temperature at time of installation (wrinkle potential of HDPE)
A minimum of 12-inches of cover soil should be on a liner prior to driving on it.
Depth of frost penetration
UV deterioration
Subgrade - do you need a liner?

GCL - Advantages:

installation is simpler, including type of equipment needed
less space is occupied by the liner
not as vulnerable to desiccation as wet compacted clays during and after installation
low hydraulic conductivity 2 x 10-11 m/s
capable of sealing punctures of diameters up to 25 mm with only a slight increase in

hydraulic conductivity
resist chemical attack when prehydrated with water

GCL-Disadvantages

must be covered after installation to prevent hydration
thinness of blanket make them susceptible to damage by puncture
may not be compatible with organic chemicals

Submitted by D. Dolhopf MSU-RRU
for Old Works cover material

Requirements for Soil

Parameter	Replacement Soil Suitability
Particle Size Distribution • Texture • Rock Fragments	See textural triangle (Figure 1) Particles >2 mm diameter constitute <20% of sample. Maximum course fragment size is one inch.
Saturation Percentage	>25% and <85%
pH	>5.5 and <8.5
Specific Conductance	<4000 μmhos/cm
Sodium Adsorption Ratio	< 10
Trace element levels	phytox cont - ballpark
• lead	<100 mg/kg 500
• arsenic	<30 mg/kg 100
• cadmium	<4 mg/kg
• copper	<100 mg/kg
• zinc	<250 mg/kg —— 500 - pH critical 250 @ pH 5.5
• mercury	<5 mg/kg
• selenium	<10 mg/kg
• silver	<2 mg/kg
• thallium	<10 mg/kg
Soil Fertility	N, P, K Nutrient Requirements Are Not Required During Soil Selection.

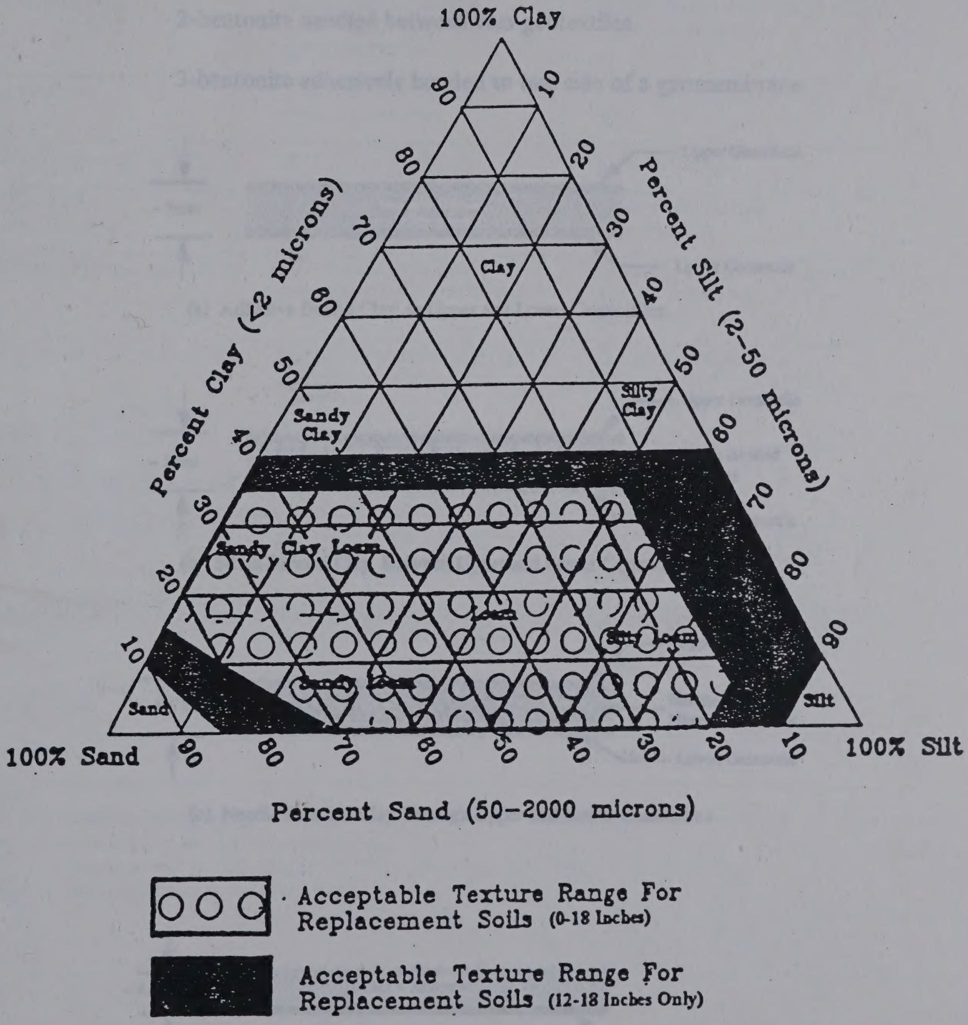


Figure 1. Acceptable texture range for replacement material.

2.4 Geosynthetic Clay Liners (GCL)

1 company is buying up all of — GCL manufacturers

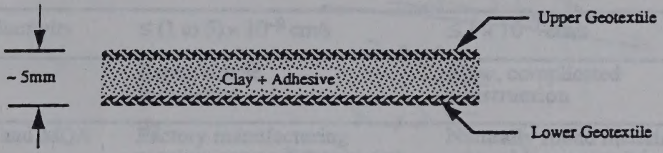
General Form: Bentonite granuals (≈ 1 lb/ft2) are mechanically or adhesively attached to a geotextile or geomembrane.

Specific Forms:

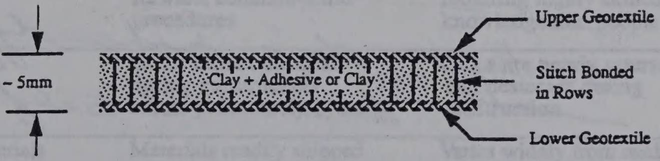
1-bentonite adhesively bonded between two geotextiles

2-bentonite needled between two geotextiles

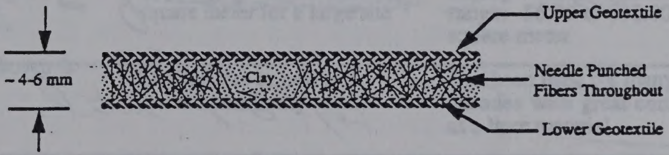
3-bentonite adhesively bonded to one side of a geomembrane


Upper Geotextile
~ 5mm
Clay + Adhesive
Lower Geotextile

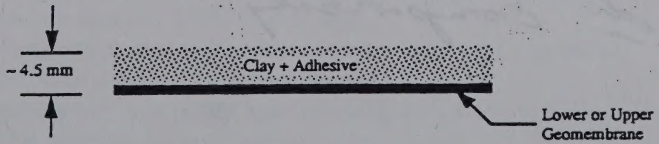
(a) Adhesive Bound Clay to Upper and Lower Geotextiles


Upper Geotextile
~ 5mm
Clay + Adhesive or Clay
Stitch Bonded in Rows
Lower Geotextile

(b) Stitch Bonded Clay Between Upper and Lower Geotextiles


Upper Geotextile
~ 4-6 mm
Clay
Needle Punched Fibers Throughout
Lower Geotextile

(c) Needle Punched Clay Through Upper and Lower Geotextiles


~ 4.5 mm
Clay + Adhesive
Lower or Upper Geomembrane

(d) Adhesive Bound Clay to a Geomembrane

See Attachment C - Reference on Basic GCL Properties

GCL

Problem
- ↑head
- organics
- 4:1

overlap - dzn make dif.
Seams l self seal

dsn use to substitute 6 2' of clay
has used in Ldfl in combination
w/ oth mtl.

still nd compacted soil below
low permeability
do compatibility.

Differences Between GCLs and CCLs

Characteristic	Geosynthetic clay liner	Compacted clay liner
Materials	Bentonite, adhesives, geotextiles, and geomembranes	Native soils or blends of native soils and bentonite
Thickness	Typically 7 to 10 mm (when hydrated)	Typically 300 to 900 mm
Hydraulic conductivity	$\leq (1 \text{ to } 5) \times 10^{-9}$ cm/s	$\leq 1 \times 10^{-7}$ cm/s
Speed of construction	Rapid, simple installation	Slow, complicated construction
Need for MQC and MQA	Factory manufacturing requires constant monitoring	Naturally found materials or mineral layers requiring no monitoring
Status of CQC and CQA	Relatively simple, straightforward, common-sense procedures	Complex procedures requiring highly skilled and knowledgeable people
Field desiccation sensitivity	GCLs cannot desiccate during construction unless prematurely hydrated	CCLs are nearly saturated; can desiccate during construction
Available of materials	Materials readily shipped to any site	Varies widely from readily available to not available at all
Installed Cost	Typically $6.00 to $8.00 per square meter for a large site	Highly variable -- estimated range: $6.00 to $30.00 per square meter
Experience	Limited due to newness and nonfamiliarity	Has been used for many decades with great confidence as a liner material

Note:
MQC = manufacturing quality control
MQA = manufacturing quality assurance
CQC = construction quality control
CQA = construction quality assurance

DEPARTMENT OF ENVIRONMENTAL QUALITY

MARC RACICOT, GOVERNOR

STATE OF MONTANA

(406) 444-2544

PO BOX 200901
HELENA, MONTANA 59620-0901

MEMORANDUM

TO: Andy Young

FROM: Judy Reese

DATE: ~~January 24, 1997~~

SUBJECT: UBMC Repositories

Pat. - see updated overview

This memo is in response to your questions regarding the design of the repositories constructed, to date, at the UBMC. The Paymaster repository is scheduled to be built in 1996.

Upper Carbonate Repository

- - Built into the existing hillside.
- - Runon control ditch between top of repository and hillside.
- - Runoff control ditch between the side of the repository and the adjacent hillside.
- - Slightly sloped top with 12" of soil ontop of a GCL.
- - Side slope 2:1 (and steeper).
- - Side slope has an 8"-16" layer of gravel covered by 9"-30" of topsoil.
- Approximately, 23,000 cubic yards were placed in this repository.
- All wastes were compacted in lifts and density confirmed in the field.
- ~~All~~ waste was limed with 1/4" quicklime (approximately 10%). At this rate the wastes were fully neutralized. The Companies did this because they could not get the required compaction due to moisture in the wastes.
- Two neutron probes were placed into the side slope (through soil, gravel and waste). Data delineates a wetting front moving into the waste (see attached). Vegetation should decrease the amount of moisture moving into the wastes.
- Note the actual field thickness of the cover (soil and gravel) is greater than that specified in the plans (see attached 2306-C9 drawing).
- The entire site was seeded and germination has been very successful.
- Erosion problems were addressed and repaired in 1995.
- One monitoring well was placed approximately 60' downgradient of the repository.
- The plans are attached for your review.

Lower Carbonate

The gravel drainage layer was a "test" design. It was probably unnecessary. The particle size of the cover soil was susceptible to piping into (and clogging) the gravel drain. It clogged!

Overall this was a very good design. I believe liming the waste is a critical factor if acid rock drainage is to be prevented in the long term.

Mike Horse Repository

Problems:

- The location is totally inappropriate (within 50' of a perennial stream, in a steep drainage which receives 20+ inches of precipitation annually).
- Prior to construction bedrock seeps were present at the southwest corner of the proposed repository location. The Companies placed french drains below the repository subgrade to prevent saturation of the waste. One french drain was ponded with water in July 1995.
- We requested that the entire waste pile be amended with lime. The Companies refused to do this. The plan called for the top 18" to be amended with kiln dust. Due to contract error, the percent of kiln dust added was inadequate to provide neutralization.

Design:

- The design plans are attached. Note this repository is designed with a sludge drying bed placed on top.
- The top 18" of waste was amended with kiln dust.
- The wastes were compacted in lifts approximately 2' thick. Daily density measurements taken, areas were recompacted, if necessary.
- 12" of coversoil was placed ontop of the compacted wastes amended with kiln dust.
- A runoff control ditch was placed on the sideslope of the repository
- Approximately 25,000 cubic yards (?) of waste was placed in this repository.
- This repository will be completed in 1996.
- A runon control ditch will be placed above the repository.
- A GCL will be placed on the flat (top) part of the repository.
- There is one monitoring well downgradient of the repository.
- The french drain water quality is being monitored.
- It is my opinion that acid rock drainage in the future is inevitable from this repository.

Miscellaneous Repository Information

The following information is from the discussions regarding repositories in Montana with the MSU Reclamation Research Unit:

> 12" of coversoil on unamended wastes has not been successful in Montana (eastern or western)

In eastern Montana an acid generating coal waste pile was amended with lime and 6" of topsoil placed ontop. This failed. At this same location 18" of top soil placed ontop of 6" of amended waste. This failed. The entire waste pile was amended.

At Zortman the following design was successful:

1' cover soil
2' coarse waste rock (low sulfur, <2%)
1' clay
3' low sulfur rock
wastes

Golden Sunlight has tried different designs and conducted extensive monitoring. Sorry, but I don't have the details.

The DEQ-AMB is amending entire waste rock piles prior to placing a cap on the top.

Attachs.

Jev
cIF

______ UBMC
18-02-25/06
Record: Yes____ No ✓
Administrative Record #________
Confidential: Yes________ No ✓
Key Words/Comments:________

From: JUDY REESE
To: CB5646, CB5648
Date: 2/28/96 10:50am
Subject: 1/31/96 repository corrections

Please not the following changes on the memo to Andy from me dated 1/31/96:

Page 1 All of the carbonate wastes were not limed all of the LOWER carbonate wastes were limed.

Page 3 (note page #'s are goofed up) The eastern Montana coal waste pile referred to is know at " Lehi". Per J. Goering 2/96 the following is the accurate scenario:

original amendment rate 20T/1000 incorporated into top 1 foot
top soil was 3-6"
* 15" root zone was utilized by vegetation .. acid burn....death...
this did not last for 1 year
in 1996 they will be digging up the wastes & fully amending the pile at a cost of approximately $3 million

Also, MSU hopes to be examining and comparing sugar beet wastes, cement kiln dust and quicklime under a RIT grant. - NOT selling it

~~For 1996 Continental Lime facility waste material (Townsend) has all been purchased by amb. I believe this is for the Lehi project.~~

STATE SUPERFUND AND ABANDONED MINE MINE WASTE REPOSITORIES

Three state superfund and two abandoned mine waste repositories have been constructed since 1993. The following is an overview of these repositories:

Upper Carbonate Repository
Upper Blackfoot Mining Complex, Lewis and Clark County

- Approximately 23,000 cubic yards of mine waste and tailings were placed in this repository.
- It was built into the existing hillside.
- There is a run-on control ditch between the repository top and the hillside.
- There are run-off control ditches along the sides of the repository and the adjacent hillside.
- The top is slightly sloped into the hillside, covered by a GCL and covered with 12" of top soil.
- Side slope 2:1 (and steeper).
- The side slope has an 8"-16" layer of gravel covered by 9"to 30" of topsoil. The purpose of the gravel was to serve as a drainage layer. This was not successful due the piping of the overlying soils into the gravel.
- Note the actual field thickness of the cover (soil and gravel) is greater than that specified in the plans (see attached 2306-C9 drawing).
- All wastes were compacted in lifts and density confirmed in the field.
- 15,400 cubic yards of waste and tailings placed on top was limed with 1/4" quicklime (approximately 10%). At this rate, the wastes were fully neutralized.
- Two neutron probes were placed into the side slope (through soil, gravel and waste). Data delineates a wetting front moving into and through the waste. Vegetation should decrease the amount of moisture moving into the wastes.
- The entire site was seeded and plant establishment has been very successful.
- One monitoring well was placed approximately 60' down gradient of the repository.
- The plans are attached for your review.

Mike Horse Repository
Upper Blackfoot Mining Complex, Lewis and Clark County

- Approximately 35,000 cubic yards of mine waste were placed in this repository.
- The design plans are attached. Note this repository is designed with a sludge drying bed placed on-top.
- The depth to groundwater is zero to 3 feet.
- The top 18" of waste was inadequately amended with kiln dust due to contractor error.

- The wastes were compacted in lifts approximately 2' thick. Daily density measurements were taken and areas were recompacted, if necessary.
- 12" of coversoil was placed on top of the compacted wastes amended with kiln dust.
- A run-off control ditch was placed on the side slope of the repository
- A run-on control ditch was placed above the repository.
- A GCL was placed on the flat part (top) of the repository.
- There is one monitoring well down gradient of the repository.
- The french drain water quality is being monitored.

ASARCO and ARCO built this structure at their own risk as part of ongoing voluntary remedial actions at the Upper Blackfoot Mining Complex. The State has gone on record as opposing this repository for the following reasons:

- The location is totally inappropriate (i.e., within 50' of a perennial stream, in a steep and narrow drainage which receives 28+ inches of precipitation annually).
- Prior to construction bedrock seeps were present at the southwest corner of the proposed repository location. The Companies placed french drains below the repository subgrade to prevent saturation of the waste from the seeps. One french drain was ponded with water in July 1995.

Paymaster Repository
Upper Blackfoot Mining Complex, Lewis and Clark County

This structure was started in 1996 and will be completed in 1997.

- The maximum capacity of this repository is 27,000 cubic yards.
- The side slopes will be 3:1.
- The top area will be sloped at 2 to 5 percent into the hillside.
- There will be a run-on control ditch around the top and sides of the repository.
- Twelve inches of growth medium will be placed on-top of the repository.
- All wastes were/will be amended for existing and potential acid production. A quality assurance/quality control plan was implemented which consisted of sampling lifts of wastes in the repository staging area at a rate of every 200 cubic yards. The results of these analyses were used to establish specific incorporation rates per lift, plus 25 percent additional amendment material was added for conservatism. The purpose of this plan was to ensure that the waste material is fully amended.
- The repository is more than 1,000 feet from the Blackfoot River.
- Two settling monuments will be installed on the repository.
- No down gradient groundwater monitoring will be required because the wastes were/will be fully neutralized.

Vosberg Repository - *Abandoned Mine Program*
Broadwater County

- Approximately 16,500 cubic yards and tailings and 6,000 cubic yards of waste rock were placed in this repository.
- The distance to groundwater is approximately 200 feet.
- The distance to surface water is 2,200 feet.
- The structure is located with a saddle and it essentially flat
- There is a leachate collection system along the base of the repository.
- There is a GCL on the bottom and top of the repository, completely encapsulating the waste
- A run-on control ditch was constructed up gradient of the repository.
- Total project cost was $944,087.

Brooklyn Repository - *Abandoned Mine Program*
Granite County

- Approximately 9,000 cubic yards of mine tailings were placed in this repository
- The distance to groundwater is 30 feet.
- The distance to surface water is 700 feet.
- The surrounding lithology is Madison limestone.
- There is a leachate collection system along the base of the repository.
- There is a GCL on the bottom and top of the repository, completely encapsulating the waste.
- The side slope is 4:1.
- Two feet of cover soil was placed on top of the repository.
- Run-on control was installed up gradient of the repository and runoff control down gradient of the repository.
- The total cost of this structure was $362,464, including repository construction, wasted excavation and placement, capping and revegetation.

ATTACHMENT VI

Repository Literature Review

Many researchers have recognized problematic issues with designing containment systems for leachable mine wastes such as tailings or waste rock. Documented mechanisms of long-term failure include: initial flaws in barrier construction, shrink-swell cycles, freeze-thaw cycles, surface erosion, subsidence, root intrusion and animal intrusion. Many of these potential concerns with failure can be categorized into two areas: caps and leachate collection.

CAP TYPES

Most caps address concerns related to fugitive dust. Currently there are two distinct mechanisms used in the design of caps to limit infiltration. The most common closure designs use barrier layers (Type 1) to limit the rate of infiltration and lateral drainage layers to remove moisture building up on the barrier. The alternative mechanism used to limit infiltration is a water-balance design (Type 2) that balances the net infiltration into surface loam with ET potential of surface vegetation. Water balance covers use a surface layer of loam to hold the moisture and provide a rooting layer for vegetation. Moisture that infiltrates into the loam is prevented from flowing down and out of the loam by a capillary break layer placed immediately beneath it. Most modern day leachable mine waste capping requirements avoid water balance caps for the obvious reason of the inability to determine adequate protectiveness.

Type 1

Most modern barrier systems utilize a multi-layered design to substantially reduce infiltration. Starting from the bottom to top of the cap, most utilize: three to six inches of compacted clay, a 15 -20 mil. PVC synthetic liner, a geotextile liner shield, a two- to three-feet capillary break, and 20 to 30 inches of growth media. The design also allows lateral drainage so water will not mound on top of the cover. If only a compacted clay layer is utilized without a synthetic liner, the compacted clay material must be protected from freeze-thaw cycles. In the UBMC area the frost depth usually exceeds three to four feet. Freeze-thaw cycles will crack the clay and allow precipitation to by-pass the clay unit and infiltrate directly into the waste materials. Therefore, if only a clay barrier is constructed, the clay material would need to be placed at least 36 to 48 inches below the ground surface.

An increased thickness growth media provides other benefits beyond preventing infiltration, such as limiting the effects of freeze-thaw cycles and providing a better substratum for vegetative establishment. According to Munshower (1993):

> *"Development of a complete, self-perpetuating, and diverse plant community in thin soil layers will not occur. Plant roots do not penetrate limestone covers or acid materials and a 40-to -50 cm* **[16 - 20 in]** *rootzone is not thick enough to support long-term growth of multiple plant species in dry regions. Even a 50-cm* **[20 in]** *rootzone over an impermeable*

clay cap is inadequate for all but a small number of shallow-rooted species."

Type 2

In an article addressing natural recharge mechanisms, Stephens (1993) states "Extensive studies document that significant recharge can occur in arid and semiarid climates, even where annual potential evapotranspiration [ET] exceeds precipitation." This argument has long since been addressed. An appropriate thickness of soil/fill material will provide for the required storage of precipitation during those months when ET is very low (October through May). It is in the early spring when storage is critical, and when the field capacity of the soil can be exceeded, allowing infiltrating water to drain into the waste sources and, potentially, into the adjacent aquifer. In a cap-water-storage-capacity study performed at the Idaho National Engineering Laboratory (INEL), Anderson, et al., (1993) determined that the soil proposed for capping of waste materials had a water storage capacity of 17% (by volume). They concluded that a cap of 1.6 - 2.0 meters (5.25 - 6.44 ft) would be needed to store INEL's expected annual precipitation 8.7 inches.

References

Anderson, J.E., R.S. Nowak, T.D. Ratzlaff, and O.D. Markham, 1993. "Managing Soil Moisture on Waste Burial Sites in Arid Regions", J. Environ. Qual, Volume 22:62-69.

Fetter, C.W, 1988, Applied Hydrogeology, Merrill Publishing Company, pp 80.

Freeze, R.A. and J.A. Cherry, 1979. Groundwater, Prentice Hall. pp 29.

Munshower, Frank F., 1993, Practical Handbook of Disturbed Land Revegetation, Lewis Publishers, pp 184-185.

Schafer, W.M., J.G. Goering, T.R. Grady, E. Spotts, and D.R. Neuman, 1994. "Modeling Recharge and Runoff to Predict Copper and Zinc Transport From Lime-amended Tailings at the Silver Bow Creek CERCLA Site", International Land Reclamation and Mine Drainage Conference and the Third International Conference on the Abatement of Acidic Drainage, Pittsburgh, PA, April 24-29, 1994.

Reclamation Research Unit, Montana State University, 1993. Bozeman, MT, Streambank Tailings and Revegetation Studies Phase III Final Report, Volume 1.

Stephens, D.B., 1993. "A Perspective on Diffuse Natural Recharge Mechanisms in Areas of Low Precipitation", Soil Sci. Am. J. 58:40-48.

ANDY Zort Pend. 7:
4

G·N·Richardson & Associates
CONSULTING ENGINEERING

Andy see page: for
Hanover reference
to 15% pea
gravel.
to control
wind erosion.

March 17, 1995

Mr. Jim Robinson
Department of State Lands
P.O. Box 201601
Helena, MT 59620-1601

RECEIVED
MAR 17 1995
STATE LANDS

RE: Engineering Peer Review
PDEIS Zortman/Landusky Mines

Dear Jim:

I have completed my peer review of the PDEIS for the referenced project. This review has focused on Alternatives 5 and 6 as proposed by the agencies. In general, I find the proposed designs for low-infiltration covers in these alternatives are inadequate and offer a low potential for limiting the long-term surface water infiltration of the rock waste and tailings to be covered. This letter report presents a detailed summary of my concerns and provides general recommendations regarding closure systems that I feel would be effective.

Additionally, I have reviewed the general design concept for the Zortman Mine heap-leach pad proposed for Goslin Flat and the agencies' alternative at Upper Adler Gulch. Documents reviewed include the design conceptual report and drawings prepared by Golder Associates. I have provided comments regarding the design of both facilities.

REC
DEC 26 1995
Environment

Project Background

The PDEIS is being prepared in anticipation of the following significant actions at each of the mines:

- Closure of existing waste rock piles and spent heap leach mounds, and
- Expansion of the mining operation including enlargement of the quarry pits and construction of a new heap leach pad and waste rock repository at the Zortman Mine.

417 N. BOYLAN AVENUE • RALEIGH, NORTH CAROLINA 27603 • TEL. 919-828-0577 • FAX 919-828-3899

Recycled Paper

This peer review is specifically focused on an evaluation of the proposed final covers for the waste rock tailings piles and the design of the proposed heap leach pad. In several instances the peer review raises questions that should be clarified by the design engineers prior to completion of permitting. The peer review is not intended to provide final design nor relieve the engineers of record from their design/permit obligations.

Zortman Mine ---- The Zortman mine would process 60,000 to 80,000 tons of ore daily, with approximately 36% of that volume being waste rock. Most of the ore to be processed at Zortman is not oxidized and must be crushed prior to placement of the leach piles. The mine currently has 5,000,000 tons of waste rock , 116 acres of depleted or soon to be depleted heap leach mounds requiring closure, and a total impacted acreage of 401 acres. The waste rock is classified according to its potential to produce ARD: Blue waste rock contains <0.2% sulfur and will not produce ARD, Yellow waste rock has 0.2 to 0.5% sulphur and is 'uncertain' regarding ARD, and Green waste rock has >0.5% sulphur and will generate ARD. The PDEIS does not provide estimated tonnage available for each classification. The current soil inventory at the mine includes approximately 183,000 yd^3 of available cover soil.

Clay soils used at the mine are obtained from the Seaford Clay Pit located south of the town of Zortman. The proposed closures would use up to 500,000 tons of clay from this source. The PDEIS includes consideration of the final closure of the clay pit, approximately 9 acres.

The existing mine and the proposed Goslin Flat leach pad are located between elevations 3600 and 5300 feet. Based on data from the Zortman mine meteorological station, the total annual precipitation is less than 15 inches and the 24-hour maximum precipitation is approximately 6 inches. The Golder report, however, indicates a mean annual precipitation of 17.9 inches, a 100-year 24-hour storm of 3.94 inches. Golder does indicate that the proposed leach pad was designed for runoff from a 6-inch design storm. An annual pan evaporation of 62.5 inches is used in the Golder study (Appendix C-3) while an annual evaporation rate of 40.5 inches is reported in the PDEIS and referenced to Klohn Leonhoff, May, 1989.

Actual mean annual precipitation and pan evaporation will be influenced by elevation and will therefore vary somewhat over the sites of the two mines.

Landusky Mine ---- The Landusky mine processes approximately 20,000 tons of ore daily, with approximately 36% of that volume being waste rock. No ore is crushed at the Landusky mine due to the degree of oxidation of the rock. The mine currently has 235 acres of open pits, 171 acres of waste rock repositories, and 280 acres of depleted or soon to be depleted heap leach mounds, and a total of 814 disturbed acreage. The current soil/tailings inventory at the mine includes 2,172,000 yd^3 of cover soil.

Clay soils used at the mine are made by compaction of weathered shales. It is assumed that the clay liners for proposed leach pads and compacted clay barriers would be made of compacted weathered shales.

The mine elevations and precipitation data is assumed to be equal to that for the Zortman mine.

Final Closure Alternatives

The PDEIS presents final cover designs for the following applications:

- Pit Floor Cover
- Pit Bench Cover - ARD Potential
- Pit Bench Cover - No ARD Potential
- Reclamation Cover A - ARD Potential on haul roads
- Reclamation Cover B - Slopes > 5% (waste rock and heap leach facilities)
- Reclamation Cover C - Slopes < 5% (waste rock and heap leach facilities)

With the exception of the pit bench cover where there is little potential for ARD, all of the cover sections must limit the infiltration of moisture to the underlying waste rock, spent ore, or pit floor. Alternatives 5 and 6 require all disturbed area to be covered with Reclamation Covers B and C modified to increase the CCL from 3-inch to 6-inch.

Currently there are two distinct mechanisms used in the design of final covers to limit infiltration. The most common closure designs use (1) barrier layers to limit the rate of infiltration and lateral drainage layers to remove the moisture building up on the barrier. This system has been pushed and researched primarily by USEPA. The alternative mechanism used to limit infiltration is (2) a water-balance design that balances the net infiltration into a surface loam with the evapotranspiration potential of surface vegetation. Water-balance covers use a surface layer of a loam to hold the moisture and provide a rooting layer for the vegetation. Moisture that infiltrates into the loam is prevented from flowing down and out of the loam by a capillary break layer placed immediately beneath it. This is based on a phenomena called Richard's Effect (Richards, 1950). Richard's Effect simply states that a fine grained soil layer will not give up moisture to a coarse grained layer immediately beneath it until the fine grained layer becomes saturated. Essentially, the capillary tensions formed in the fine grained layer hold the moisture and prevent it from draining under gravitational forces. The loam simply acts as a sponge. The proposed final covers in the PDEIS contain elements of both barrier and water-balance covers.

First let's examine the barrier elements of the proposed covers. All of the ARD covers include a compacted clay liner (CCL). Some simple basics required for success in the use of a clay liner include the following:

- The CCL must be protected from freeze-thaw cycles. For Montana, I am assuming that the frost depth equals or exceeds 3 feet. Attachment 1 shows common depths of freezing assumed by USEPA in permit review. The clay liner must therefore be placed deeper that the frost depth (approximately 3 feet beneath the ground surface). All of the proposed reclamation covers for Alternatives 5 and 6 satisfy this requirement at Landusky and at Zortman. The only exceptions are at Zortman, where the final cover over the recontoured pit would be covered by Reclamation Cover A where the total sulfur content exceeds 0.5%.

- It is not practical to construct CCLs thinner than 1 foot. This practice is not followed in the pit bench cover, and reclamation covers A and C at Landusky, and all covers at Zortman with the exception of reclamation cover C. The proposed use of 3 to 6 inch thick clay layers is not acceptable. A reasonable alternative to such thin CCLs is the use of a geosynthetic clay liner (GCL). The GCLs use a Wyoming bentonite to produce the barrier layer and have an installed cost typically less than \$0.60 per ft^2. The GCLs have also shown a resistance to degradation under freeze-thaw cycles that destroy CCLs. Attachment 2 provides some background on GCL properties.

- The performance of a CCL (or any barrier layer) is significantly improved if a lateral drainage layer is place immediately above the CCL and designed to limit the depth that water can mound on top of the CCL. As used in Alternatives 5 and 6, Reclamation

Covers B and C satisfy this requirement. Drainage requirements for these lateral drainage layers should be established prior to final design, i.e. what is the maximum head that is allowed to act on the CCL.

Examining the water-balance aspects of cover design shows an interesting problem with the covers that include a capillary break, e.g. Remediation Covers B and C. HELP3 models were run (using Havre data) for topsoil thicknesses of 8, 12, and 18 inches. The topsoil was assumed to have a field capacity of 0.19 vol/vol and a wilting point of 0.0850 vol/vol (material #6 in HELP3). The water-balance evaluations were performed to provide a guide to the moisture available in the surface layer to surface vegetation. The results of the HELP3 evaluations for water contents in the vegetative layer are as follows:

	8-inch	12-inch	18-inch
Maximum Veg. Soil Water(vol/vol)	0.1190	0.1361	0.1742
Minimum Veg. Soil Water(vol/vol)	0.0318	0.0457	0.0673

These quick analyses indicate two facts: 1-even the 8 inch topsoil layer has sufficient field capacity to prevent the infiltration of moisture to the underlying capillary break layer, and 2-all of the topsoil profiles become desiccated sufficiently at some point during the year to produce severe stress in vegetation present. While these evaluations are cursory, I am involved in closure projects in regions having similar rainfall and feel that the 'agricultural' layer required for vegetation survival is much thicker. Attachment 3 shows the cover profile for a uranium tailings repository in Utah that is designed for an annual rainfall of approximately 15 inches. My estimate is that, for the Zortman/Landusky sites, a minimum thickness for survival of the agricultural layer would be 30 inches. Certainly the impact on the vegetation of extended periods of desiccation should be evaluated. Additional references for water-balance design considerations are provided in the references attached.

Based on this review, I would reject any cover design that called for a CCL less than 12 inches thick and placed less than 36 inches below the ground surface. Additionally, all cover designs should be required to demonstrate that they can properly support the vegetation proposed. This is particularly important in terms of the impact of stressed vegetation of surface erosion. Unfortunately, the region appears to receive its maximum precipitation during months that have a high potential for stressed vegetation. The HELP3 evaluations do indicate that a water-balance cover would be very effective in limiting infiltration and could be used to justify elimination of the CCL in all but the most critical covers. Well designed water-balance covers are typically impacted most significantly by man related activities such as over-grazing or farming on the cover. The use of water-balance covers at the Landusky mine may be particularly economical given the large stockpile of cover soil available there.

General Closure Considerations

Given the potential stressed state of the vegetation, an important consideration is the level of erosion that the final covers will experience. This is made even more important given that the proposed closures include slopes as steep as 2H:1V, swales placed every 100 ft vertical or 200 ft slope length, and the existence of a design precipitation event of 6 inches in 24 hours. The goal of limiting erosion loss to less than 2 tons/acre/year is one that I have pushed in my EPA and ASCE courses and one that has been codified for Subtitle C (hazardous) landfills. Reviewing the universal soil loss solution presented in Appendix E of the PDEIS, I am concerned with the value assumed for C, the crop management factor. This factor is the most empirical and can reasonably vary by more than an order of magnitude. Typical values for C are shown on Attachment 4. The values of C assumed in the PDEIS range from 0.006 to 0.009 and supposedly reflect the presence of more than 50% exposed rock. These values seem an order of magnitude too low and should be well documented before they are accepted, particularly in view of the high potential for stressed vegetation. I have attached as Attachment 5 the PDEIS referenced article on the revised universal soil loss equation (RUSLE) for your review. I do not have the revised SCS-ARS soil loss manual but would strongly suggest that you obtain it prior to approval of Appendix E.

Data from wind tunnel testing at DOE-Hanford has shown that as little as 15% of pea gravel size particles in the topsoil will successfully limit wind erosion. Assuming the high rock content referenced in the PDEIS, it appears that wind related erosion will not be a problem at either mine site.

There are several additional smaller concerns related to the proposed cover designs as follows:

- A geotextile filter/separator should be placed between the surface agricultural layer and the underlying 'capillary break' layer to prevent loss of fines into the capillary break. Soil particle size analysis data should be used in selecting the required AOS of the geotextile.

- The PDEIS calls for the use of a 5 ounce/yd^2 nonwoven as a cushion in Reclamation Cover C between the gravel forming the capillary break and the underlying geomembrane. This weight of nonwoven is generally not adequate for use as a cushion for gravels larger than approximately 1.0 inch. I am currently running a full scale test of cushions to protect HDPE and polypropylene geomembranes from damage due to gravels having a maximum particle size of 1.5 inch. I will provide you with a copy of this report when it is completed.

These details may be clarified when the engineering design reports are submitted for the final covers.

Leach Pad Design Review

This review included the Golder report on the leach pad proposed for Goslin Flats and the Alternatives 5 and 6 conceptuals for location of the leach pad at Upper Adler Gulch.

The proposed Goslin Flats Heap Leach Pad provides a composite barrier beneath the pad consisting of a 30-mil textured PVC geomembrane overlying a minimum 12 inch thick CCL. This composite liner is adequate to protect the adjacent environment assuming construction is monitored by a comprehensive construction quality assurance (CQA) program. I've rarely seen good CQA programs implemented when they were not required by the appropriate regulatory agency. Golder does error in assuming that the allowable strain in a PVC geomembrane is 350%. In actuality, the allowable strain should be defined by a biaxial stress test and will be approximately 40 %. Typical data from PVC geomembrane tested biaxially is presented in Attachment 6.

The use of center drained sumps is reasonable. By locating the sumps in the center of the cells, the differential settlements resulting from placement of the ore actually improves the drainage of leachate to the sumps. I would review the potential need for a cushion layer between the gravel and the geomembrane within the sump area. Even with the slip pipe around the riser, there exists a potential for downdrag forces on the riser during the settlement of the ore. In general, the proposed leach pad is consistent with current standard practice in liner design.

The agency proposed Upper Adler Gulch Leach Pad will be very difficult to line using the PVC and CCL composite liner proposed because of the steepness of the sideslopes. The gulch sidewalls appear to slope at approximately 1.5H:1.0V. This is steeper than 33° and exceeds the 12.5° assumed by Golder for the PVC interface friction angle. Construction of CCL at this slope requires placement of wide horizontal lifts and significant trimming of the as constructed CCL. These slopes might be possible if a GCL is substituted for the CCL on the slopes and if the ore is placed in a manner that does not cause overall slope stability failure of the waste.

Summary

The closure designs presented within the PDEIS do not appear to be adequately designed and have the potential for both excessive infiltration and surface erosion. Specific information should be supplied by the designer in response to the questions raised by this review. At a minimum, I would suggest that the proposed covers be evaluated in lysimeters prior to the mines spending the considerable sums required to construct these closures. The design of the Goslin Flat leach pads does appear to be adequate and reflects current practice in the industry.

I appreciate the opportunity to work with the State of Montana on this PDEIS review. If further clarification of my concerns is required please contact me.

Cordially,
G.N. Richardson & Associates

Gregory N. Richardson, Ph.D., P.E.
President

attachments:
1 - Depth of Freezing
2 - GCL Reference
3 - Water-Balance Cover for Uranium Tailings Repository
4 - Universal Soil Loss Equation - Crop Management Factor
5 - Revised Universal Soil Loss Equation (RUSLE)
6 - Biaxial Stress-Strain for Geomembranes

Water-Balance Cover References

Anderson, J.E., R.S. Nowak, T.D. Ratzlaff, and O.D. Markham, 1993. "Managing Soil Moisture on Waste Burial Sites in Arid Regions," J. Environ. QuaL, Volume 22:62-69.

Anderson, J.E., M.L. Shumar, N.L. Toft, and R.S. Novak, 1987. "Control of the Soil Water Balance by Sagebrush and Three Perennial Grasses in a Cold-Desert Environment," Arid Soil Res.Rehab., Volume 1:229-244.

Bjomstad, B.N., and S.S. Teel, 1993. Natural Analog Study of Engineered Protective Barriers at the Hanford Site, PNL-8840, Pacific Northwest Laboratory, Richland, Washington.

Burt, C.J., and S.W. Cox, 1992. Vegetation Growth Pattems on Six Rock-Covered UMTRA Project Disposal Cells, LTMTRA-DOE/AL 400677, Uranium Mill Tailings Remedial Action Project, U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico.

Caldwell, J.A., 1992. "Engineering Perspectives for Near-Surface Disposal," Deserts as Dumps? The Disposal of Hazardous Materials in Arid Ecosystems, pp. 161-198, University of New Mexico Press,Albuquerque. New Mexico.

Campbell, M.D., G.W. Gee, R.R. Kirkham, S.J. Phillips, and N.R. Wing, 1991. "Water Balance Lysimetry at a Nuclear Waste Site," in "Lysimeters for Evapotranspiration and Environmental Measurements," R.G. Allen, T.A. Howell, W.O. Pruitt, I.A. Walter, and M.E. Johnson. Am. Soc. Civ.Eng., New York, New York.

Daniel, D.E., 1994. "Surface Barriers: Problems, Solutions, and Future Needs," In G.W. Gee and N.R. Wing (ed), In-Situ Remediation: Scientific Basis for Current and Future Technologies, pp. 441-487, Battelle Press, Richland, Washington.

Davis, L.A., and S.P. Neuman, 1983. Documentation and User's Guide: UNSAT2-Variably Saturated Flow Model, prepared by Water, Waste & Land, Inc., Fort Collins, Colorado, for the U.S. Nuclear Regulatory Commission, Washington. DC.

Fayer, M.J., M.L. Rockhold, and M.D. Campbell, 1992. "Hydrologic Modeling of Protective Barriers: Comparison of Field and Simulation Results," Soil Sci. Soc. Am. J., Volume 56:690-700.

Foxx, T.S., G.D. Tiemey, J.M. Williams, 1984. Rooting Depths of Plants Relative to Biological and Environmental Factors, LA-10254-MS, Los Alamos National Laboratory, Los Alamos, New Mexico.

Gee, G.W., M.D. Campbell, H.D. Freeman, and J.F. Cline, 1989. Assessment of Cover Systems at the Grand Junction, Colorado, Uranium Mill Tailings Pile: 1987 Field Measurements, PNL-6762, Pacific Northwest Laboratory, Richland, Washington.

Gee, G.W., M.J. Fayer, M.L. Rockhold, and M.D. Campbell. 1992. "Variations in Recharge at the Hanford Site," Northwest Sci., Volume 66:237-250.

Hakonson, T.E., L.J. Lane, and E.P. Springer, 1992. "Biotic and Abiotic Processes, " Deserts as Dumps? The Disposal of Hazardous Materials in Arid Ecosystems, C.C. Reith and B.M. Thompson, pp. 101-146, University of New Mexico Press, Albuquerque, New Mexico.

Harper, J.L., 1987. "The Heuristic Value of Ecological Restoration," Restoration Ecology: A Synthetic Approach to Ecological Research, pp. 35-45, Cambridge University Press, New York,New York.

Khire, M.V., C.H. Benson, P.J. Bosscher, and R.J. Pliska, 1994. "Field-Scale Comparison of Capillary and Resistive Landfill Covers in an Arid Climate," in Hydrology Days, Proceedings of the Fourteenth Annual American Geophysical Union, Fort Collins, Colorado, Hydrology Days Press, Atherton, California, April 5-8, 1994.

Ligotke, M.W., 1994. "Control of Eolian Soil Erosion from Waste-Site Surface Barriers," In-Situ Remediation: Scientific Basis for Current and Future Technologies, pp. 545-559, G.W. Gee and N.R. Wing, Battelle Press, Richland, Washington.

Link, S.O., W.J. Waugh, and J.L. Downs, 1994. "The Role of Plants in Isolation Barrier Systems," In-Situ Remediation: Scientific Basis for Current and Future Technologies, pp. 561-592, Battelle Press, Richland, Washington.

Melchior, K. Berger, B. Vielhaber, and G. Miehlich, 1994. "Multilayer Landfill Covers: Field Data on the Water Balance and Liner Performance," In-Situ Remediation: Scientific Basis for Current and Future Technologies, pp. 411-425, Battelle Press, Richland, Washington.

Nixon, P., S. Stenseng, R. Ogg, and M. Austin, 1994. "Conceptual Engineered Cover Design for the Solar Evaporation Ponds at the Rocky Flats Plant," In-Situ Remediation: Scientific Basis for Current and Future Technologies, ed. G.W. Gee and N.R. Wing, pp. 625-632, Battelle Press,Richland, Washington.

Nyhan, J.W., 1989. Development of Technology for the Long-Terrn Stabilization and Closure of Shallow Land Burial Sites in Semiarid Environments, LA-1 1283-MS, Los Alamos National Laboratory, Los Alamos, New Mexico.

Nyhan, J.W., T.E. Hakonson, and B.J. Drennon, 1990. "A Water Balance Study of Two Landfill Cover Designs for Semiarid Regions," J. Environ. Qual., Volume 19:281-288.

Richards, L.A., 1950. "Laws of Soil Moisture," Trans. Am. Geophys. U., Volume 31:750-756.

Sackschewsky, M.R., C.i. Kemp, S.O. Lind, and W.J. Waugh, 1995. "Soil Water Balance Changes in Engineered Soil Surfaces," Journal of Environmental Quality (accepted for publication in 1995).

Suter II, G.W., R.J. Luxmoore, and E.D. Smith, 1993. "Compacted Soil Barriers at Abandoned Landfill Sites are Likely to Fail in the Long Term," pp. 217-226, J. Environ. Qual.

van Genuchten, M. T., F.J. Leij, and S.R. Yates, 1991. The RETC Code for Quantifying the Hydraulic Functions of Unsaturated Soils, EPA/000/0-91/000, p. 81, Robert S. Kerr Environmental Research Laboratory Office of Research and Development, Ada, Oklahoma.

van der Marel, E., 1988. "Vegetation Dynamics: Pattens in Time and Space," Vegetation, Volume 77:7-19.

Waugh, W.J., M.R. Adams, and R.C. Routson, 1983. Demonstration of a Design for Shallow-Land Burial of Low-Level Radioactive Waste, American Society of Agronomy, Madison, Wisconsin.

Waugh, W.J., J.C. Chatters, G.V. Last, B.N. Bjomstad, S.O. Link, and C.R. Hunter, 1994a. Barrier Analogs: Long-Term Performance Issues, Preliminary Studies, and Recommendations, PNL-9004,Pacific Northwest Laboratory, Richland, Washington.

Waugh, W. J., and S. 0. Link, 1992. Small Lysimeters for Evaluating the Water Balance of Engineered Covers: Interim Report, GJPO-TMC-7, U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado.

Waugh, W.J., K.L. Petersen, S.O. Link, B.N. Bjomstad, and G.W. Gee, 1994b. Natural Analogs of the Long-Term Performance of Engineered Covers, pp. 379-409, Battelle Press, Richland, Washington.

Waugh, W.J., M.E. Thiede, D.J. Bates, L.L. Cadwell, G.W. Gee, and C.J. Kemp, 1994c. "Plant Cover and Water Balance in Gravel Admixtures at an Arid Waste-Burial Site," Joumal of Environmental Quality, Volume 23:676-685.

Waugh, W.J., M.E. Thiede, L.L. Cadwell, G.W. Gee, H.D. Freeman, M.R. Sackschewsky, and J.F. Relyea, 1991. "Small Lysimeters for Documentaing Arid Site Water Balance," in Lysimeters for Evapotranspiration and Environmental Measurements, R.G. Allen, T.A. Howell, W.O. Pruitt, I.A. Walter, and M.E. Johnson, Honolulu, Hawaii, Am. Soc. Civ. Eng., New York, New York,July 23-25, 1991.

Wing, N.R., and G.W. Gee, 1993. The Development of Perrnanent Isolation Surface Barriers: Hanford Site, Richland, Washington, U.S.A, WHC-SA-1799-FP, Westinghouse Hanford Company, Richland, Washington.

References - Effects of Soil Freezing

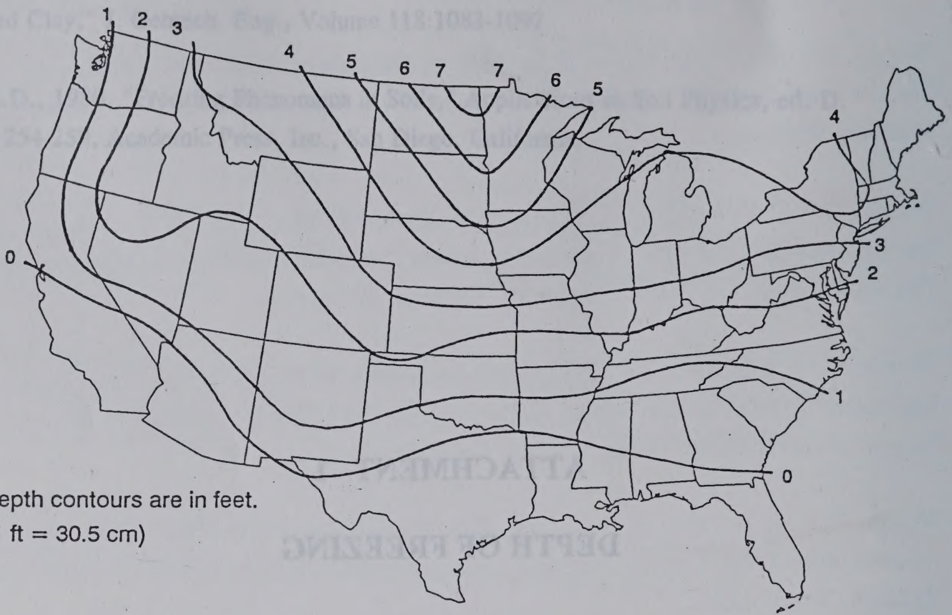
Chamberlain, E.J., and A.J. Gow, 1979. "Effects of Freezing and Thawing on the Permeability and Structure of Soils," Eng. GeoL, Volume 13:73-92.

Kim, W.H., and D.E. Daniel, 1992. "Effects of Freezing on the Hydraulic Conductivity of Compacted Clay," J. Geotech. Eng., Volume 118:1083-1097.

Miller, R.D., 1980. "Freezing Phenomena in Soils," Applications in Soil Physics, ed. D. Hille,pp. 254-259, Academic Press, Inc., San Diego, California.

ATTACHMENT 1

DEPTH OF FREEZING



Depth contours are in feet.
(1 ft = 30.5 cm)

Figure 2. Maximum anticipated depths of freezing. (Spangler and Handy, 1982)

common. Testing should be conducted under a variety of weather conditions. Without background data, it may be difficult or impossible to confirm or defend against later accusations of emissions violations. Several air sampling techniques have been described by the USEPA (1985f).

ATTACHMENT 2

GCL REFERENCE

ATTACHMENT 3

WATER-BALANCE COVER
from
URANIUM TAILINGS REPOSITORY

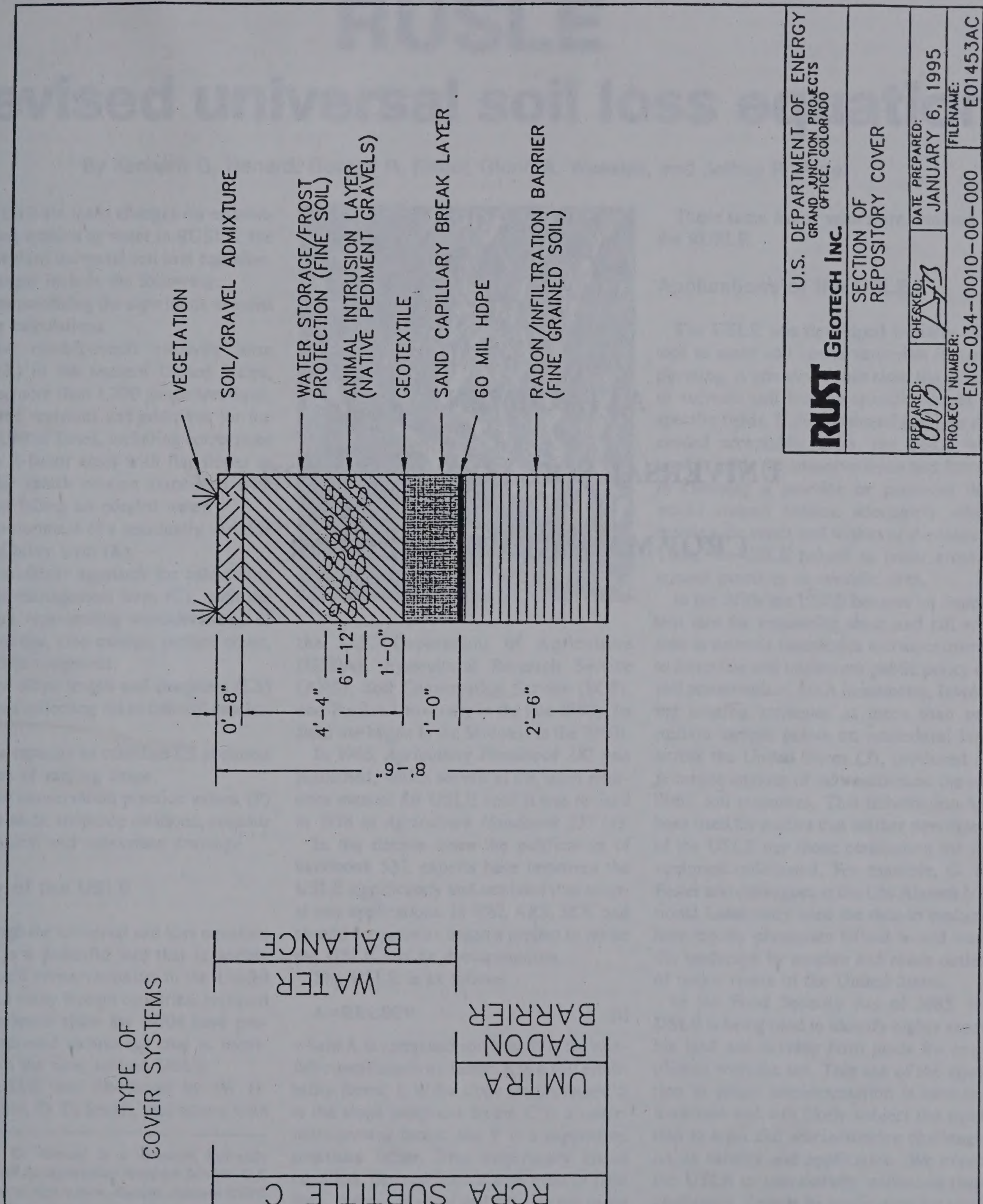

TYPE OF COVER SYSTEMS
RCRA SUBTITLE C
UMTRA RADON BARRIER
WATER BALANCE
8'-6"
0'-8"
4'-4"
6"-12"
1'-0"
1'-0"
2'-6"
VEGETATION
SOIL/GRAVEL ADMIXTURE
WATER STORAGE/FROST PROTECTION (FINE SOIL)
ANIMAL INTRUSION LAYER (NATIVE PEDIMENT GRAVELS)
GEOTEXTILE
SAND CAPILLARY BREAK LAYER
60 MIL HDPE
RADON/INFILTRATION BARRIER (FINE GRAINED SOIL)
U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION PROJECTS OFFICE, COLORADO
RUST GEOTECH INC.
SECTION OF REPOSITORY COVER
PREPARED: 00B
CHECKED:
DATE PREPARED: JANUARY 6, 1995
PROJECT NUMBER: ENG-034-0010-00-000
FILENAME: E01453AC

Figure 5–2. Section of Repository Cover

ATTACHMENT 4

UNIVERSAL SOIL LOSS EQUATION

CROP MANAGEMENT FACTOR

ATTACHMENT 4

RUSLE
Revised universal soil loss equation

By Kenneth G. Renard, George R. Foster, Glenn A. Weesies, and Jeffrey P. Porter

THERE are many changes for estimating erosion by water in RUSLE, the revised universal soil loss equation. The changes include the following:

- ► Computerizing the algorithms to assist with the calculations.
- ► New rainfall-runoff erosivity term values (R) in the western United States, based on more than 1,200 gauge locations.
- ► Some revisions and additions for the eastern United States, including corrections for high R-factor areas with flat slopes to adjust for splash erosion associated with raindrops falling on ponded water.
- ► Development of a seasonally variable soil erodibility term (K).
- ► A subfactor approach for calculating the cover-management term (C), with the subfactors representing considerations of prior land use, crop canopy, surface cover, and surface roughness.
- ► New slope length and steepness (LS) algorithms reflecting rill to interrill erosion ratios.
- ► The capacity to calculate LS products for slopes of varying shape.
- ► New conservation practice values (P) for rangelands, stripcrop rotations, contour factor values, and subsurface drainage.

History of the USLE

Although the universal soil loss equation (USLE) is a powerful tool that is widely used by soil conservationists in the United States and many foreign countries, research and experience since the 1970s have provided improved technology that is incorporated in the new, revised USLE.

The USLE was developed by W. H. Wischmeier, D. D. Smith, and others with the U.S. Department of Agriculture (USDA), Agricultural Research Service (ARS), Soil Conservation Service (SCS), and Purdue University in the late 1950s. Its field use began in the Midwest in the 1960s.

In 1965, *Agriculture Handbook 282* was published, which served as the main reference manual for USLE until it was revised in 1978 as *Agriculture Handbook 537* (*4*).

In the decade since the publication of handbook 537, experts have improved the USLE significantly and extended it to several new applications. In 1987, ARS, SCS, and several cooperators began a project to revise the USLE and its documentation.

The USLE is as follows:

$$A=RKLSCP \qquad [1]$$

where A is computed soil loss, R is the rainfall-runoff erosivity factor, K is a soil erodibility factor, L is the slope length factor, S is the slope steepness factor, C is a cover-management factor, and P is a supporting practices factor. This empirically based equation, derived from a large mass of field data, computes sheet and rill erosion using values representing the four major factors affecting erosion. These factors are:

- ► Climate erosivity represented by R.
- ► Soil erodibility represented by K.
- ► Topography represented by LS.
- ► Land use and management represented by CP.

These same factor values are retained in the RUSLE.

Applications of the USLE

The USLE was developed initially as a tool to assist soil conservationists in farm planning. A conservationist used the USLE to estimate soil loss on specific slopes in specific fields. If the estimated soil loss exceeded acceptable limits, the USLE was used to guide the conservationist and farmer in choosing a practice or practices that would control erosion adequately while meeting the needs and wishes of the farmer. Thus, the USLE helped to tailor erosion control practices to specific sites.

In the 1970s the USLE became an important tool for estimating sheet and rill erosion in national inventories and assessments to formulate and implement public policy on soil conservation. Such inventories, involving erosion estimates at more than one million sample points on nonfederal land across the United States (*3*), produced an immense amount of information on the nation's soil resources. This information has been used for studies that neither developers of the USLE nor those conducting the inventories anticipated. For example, G. R. Foster and colleagues at the Los Alamos National Laboratory used the data to evaluate how rapidly plutonium fallout would leave the landscape by erosion and reach outlets of major rivers in the United States.

In the Food Security Act of 1985, the USLE is being used to identify highly erodible land and develop farm plans for compliance with the act. This use of the equation in policy implementation is new and uncertain and will likely subject the equation to legal and administrative challenges on its validity and application. We expect the USLE to successfully withstand these challenges, despite its application for situations beyond those for which it was developed.

Originally, the USLE was developed for use on cropland. By the early 1970s it was being applied to rangeland and disturbed forest land, often stimulating controversy. Other land uses where the USLE has been

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applied include urban construction areas, recreational sites, highway embankments, mine tailings, and even coal piles. Such widespread application results from the technical soundness and the lack of alternative models for planning conservation programs to control soil erosion by water.

Wise use of prediction technology like the USLE/RUSLE requires that the user be aware of a procedure's limitations. The USLE/RUSLE is an equation that estimates average annual soil loss by sheet and rill erosion on those portions of landscape profiles where erosion, but not deposition, is occurring. It does not estimate deposition like that at the toe of concave slopes, and it does not estimate sediment yield at a downstream location. Also, it does not include ephemeral gully erosion. Furthermore, the USLE/RUSLE does not provide information on sediment characteristics, such as those needed in many water quality initiatives.

An important scientific limitation of the USLE/RUSLE as an empirically based equation is that it does not represent fundamental hydrologic and erosion processes explicitly. For example, the effect of runoff, as might be reflected in a hydrologic model, is not represented directly in the USLE/RUSLE. If the USLE is modified to account for a runoff effect, every term must be considered. Fundamental erosion processes and their interactions are not represented explicitly. An example where the USLE does not give the proper result is the deposition of sediment in furrows on flat grades. Analysis of any single data set may show significant differences between estimates with the USLE/RUSLE and observed data.

Such limited comparisons are not at all an indication of the overall performance of the USLE/RUSLE. As an empirical equation derived from experimental data, the USLE/RUSLE adequately represents the first-order effects of the factors that affect sheet and rill erosion.

The revised equation

In the meantime, the USLE remains the most powerful, widely used, and practical tool for estimating sheet and rill erosion. The current project to revise and update the USLE is nearing completion and will strengthen the technology. The update is based on an extensive review of the USLE and its data base, analysis of data not previously included in the USLE, and theory describing fundamental hydrologic and erosion processes. This update of the USLE is so substantial that the result is referred to as RUSLE—the revised USLE.

Following is a brief description of some of the improvements being made to the USLE factors in the RUSLE.

R factor. The R factor represents the input that drives the sheet and rill erosion process, and differences in R values represent differences in erosivity of the climate. For example, in Illinois, all other factors being the same, nearly twice as much erosion is expected in southern Illinois than in the northeast because of differences in climatic erosivity at the two locations.

The erosivity of rains is not distributed uniformly throughout the year. Many of the most erosive rains occur in the spring when row-cropped land is bare and ready for planting, so the soil is most susceptible to erosion when the most erosive rains occur. Thus, in assessing erosion, the magnitude of the R factor and its seasonal distribution must be addressed in relation to the cropping system.

Of the USLE factors, R is the one most exactly computed from input data: rainfall amounts and intensities. However, these data are not always available, especially in isolated areas of foreign countries. Suggestions are presented for relating R to precipitation data.

One of the major improvements in the RUSLE is a greatly improved isoerodent map for the western United States. Data from more than 1,000 locations have been analyzed to prepare the new map. The previous isoerodent map was based on a few point calculations and a procedure that related the annual R to the two-year frequency, six-hour duration precipitation amount. The current map produced point estimates in the western United States that are seven times as large as those in *Agriculture Handbook 537.*

Another change in the R factor is to reduce R values where flat slopes occur in regions of long, intense rainstorms (such as in the southeastern United States). Ponded water on the soil reduces the erosivity of raindrdop impact. Finally, an R equivalent approach is being used in the Pacific Northwest to reflect the combined effect of thawing soil and rain on snow or partly frozen soil.

K factor. The K factor is a measure of the inherent erodibility of a given soil under the standard condition of the unit USLE plot maintained in continuous fallow. Values for K typically range from about 0.10 to 0.45 (customary English units), with high-sand and high-clay content soils having the lower values and high-silt content soils having the higher values.

Because of its great range in possible values, the K factor may be of slightly greater importance, from a sensitivity point of view, than is the R factor. Users have little difficulty choosing a K-factor value because SCS has identified K values for all major soil mapping units. However, the site-specific K value can be quite different from the K value given in soil survey information.

The erodibility nomograph is the most commonly used tool for estimating K values, but it does not apply to some soils. The updating of the K factor for RUSLE involves developing guides so that the user can identify soils where the nomograph does not apply and then estimate K using alternative methods. Erodiblity data from around the world have been reviewed, and an equation has been developed that gives a useful estimate of K as a function of an "average" diameter of the soil particles.

Use of this function, however, is only recommended where the nomograph or another procedure does not apply. K values for the volcanic soils of Hawaii are estimated with an alternative algorithm to the erodibility nomograph (*1*).

The RUSLE also varies K seasonally. Experimental data show that K is not constant but varies with season, being highest in the spring with soil fluffing from freeze-thaw actions and lowest in mid-fall and winter following rainfall compaction or a frozen soil. The seasonal varibility is addressed by weighting the instantaneous estimate of K in proportion to the EI (the percent of annual R) for 15-day intervals. Instantaneous estimates of K are made from equations relating K to the frost-free period and the annual R factor.

An additional change incorporated in the RUSLE is to account for rock fragments on and in the soil. Rock fragments on the soil surface are treated like mulch in the C factor, while K is adjusted for rock in the soil profile to account for rock effects on permeability and, in turn, runoff. (Updating of the K factor values is led by M.J.M. Römkens, ARS, Oxford, Mississippi, and R. A. Young, ARS, Morris, Minnesota.)

L and S factors. More questions and concerns are expressed about the L factor than any of the other USLE factors. One reason is that the choice of a slope length involves judgment, and different users choose different slope lengths for similar situations. The RUSLE includes improved guides for choosing slope length values to give greater consistence among users.

The attention given to the L factor is not always warranted because soil loss is less sensitive to slope length than to any other

USLE factor. For typical slope conditions, a 10 percent error in the slope length results in a 5 percent error in computed soil loss.

The RUSLE uses three separate slope length relationships. They include (a) a function of slope steepness, as in the USLE, (b) a function of the susceptibility of the soil to rill erosion relative to interrill erosion, and (c) a slope length relationship specifically for the Palouse region in the Pacific Northwest. A guide helps the user identify the appropriate relationship for the particular field conditions.

Soil loss is much more sensitive to changes in slope steepness than to changes in slope length. In the present USLE, a 10 percent error in slope steepness gives about a 20 percent error in computed soil loss. Thus, special attention should be given to obtaining good estimates of slope steepness.

The RUSLE has a more nearly linear slope steepness relationship than the USLE. Computed soil loss for slopes less than 20 percent are similar in the USLE and RUSLE. However, on steep slopes, computed soil loss is reduced almost by half with the RUSLE. Experimental data and field observations, especially on rangeland, do not support the USLE quadratic relationship when extended to steep slopes. The RUSLE also provides a slope steepness relationship for short slopes subject primarily to interrill erosion and a steepness relationship for the Palouse region.

In most practical applications, a slope segment previously estimated as a single plane or uniform slope can be a poor representation of the topography. In the RUSLE complex slopes can be represented readily to provide a better approximation of the topographic effect. (Updating of the L- and S-factor values is led by D. K. McCool, ARS, Pullman, Washington).

C factor. The C factor is perhaps the most important USLE factor because it represents conditions that can be managed most easily to reduce erosion. Values for C can vary from near zero for a very well-protected soil to 1.5 for a finely tilled, ridged surface that produces much runoff and leaves the soil highly susceptible to rill erosion.

Values for C are a weighted average of soil loss ratios (SLRs) that represent the soil loss for a given condition at a given time to that of the unit plot. Thus, SLRs vary during the year as soil and cover conditions change. To compute C, SLRs are weighted according to the distribution of erosivity during a year.

In the RUSLE, a subfactor method is used to compute SLRs as a function of four subfactors: prior land use, canopy, ground cover, and within-soil effects. Ground cover affects erosion the most. But after too much attention is given to ground cover without considering the within-soil effects, such as those associated with root mass and tillage. For example, 30 percent cover after planting is the criterion frequently used for conservation tillage. A 30 percent cover reduces soil loss about 72 percent, according to the USLE. For comparison, the soil loss from a slope freshly plowed out of highly productive meadow is only 25 percent of that from the unit plot. Thus, within-soil effects can be substantial.

In the RUSLE, the subfactor relationship is given by the equation:

$$C = PLU \cdot CC \cdot SC \cdot SR \qquad [2]$$

where PLU is the prior land use subfactor, CC is the canopy subfactor, SC is the surface cover subfactor, and SR is the surface roughness subfactor.

The effect of surface ground cover on erosion has been observed to vary greatly in research studies. In some studies a 50 percent cover reduced soil loss by about 65 percent. In other studies a 50 percent cover reduced soil loss by 95 percent. To deal with this varied effectiveness in the RUSLE, the following equation is used:

$$SC = \exp(-b\ M) \qquad [3]$$

where SC is the mulch or ground cover subfactor value and M is the percentage of ground cover. The b coefficient is assigned a value of either 0.025, the value in the present USLE; 0.035, the new "typical" value in the RUSLE; or 0.050 for certain conditions. The value of b is increased as the tendency for rill erosion to dominate over interrill erosion for the soil increases. Guidelines are provided on choosing the b value.

Subfactor values (PLU and SR) for the within-soil effect are calculated from the amount of biomass in the soil that accumulates from roots and incorporation of crop residue The RUSLE computes biomass decomposition on and in the soil using a residue decomposition model (*2*). Characteristics of tillage operations are important in computing estimates of subfactor values for SLRs. Values for SLRs in the RUSLE for conservation tillage likely will be less than those of the USLE because RUSLE computes greater effectiveness for ground cover.

One reason for the subfactor approach in the RUSLE is for applications where SLR values are not available. For example, no experimental erosion data exist for many vegetable and fruit crops, such as asparagus and blueberries. Developing SLR values using the subfactor method in the RUSLE is easier and more accurate than making comparisons with values in table 5 of *Agricultural Handbook 537* when none of the crops listed in the table closely matches the characteristics of the crop for which new values are needed.

The RUSLE has computer routines for many tillage operations and crops. In other instances, the user must input new data reflecting the amount of residue incorporated by a tillage operation and the roughness residual following tillage. For crops not available in the computer program, data are needed to reflect canopy characteristics and root mass in the upper four inches of the soil profile. Thus, the user must specify the crops in a rotation; crop yield; and the dates of operations, such as tillage and harvest. The computer calculates SLRs and the average annual C-factor.

Grazing effects on rangeland, pasture, and meadow are reflected in the effect of canopy height, ground cover, and root biomass. Finally, ground cover as used in the USLE reflected vegetation and litter; in the RUSLE, ground cover is given as 1.0 minus the amount of bare soil that reflects the addition of litter in the form of rock and stone besides the conventional vegetative litter. (Updating of the C-factor values for cropland is led by J. M. Laflen, ARS, West Lafayette, Indiana; J. P. Porter, SCS, Flint, Michigan; and J.R. Simanton, ARS, Tucson, Arizona).

P factor. Of all the USLE factors, values for the P factor are the least reliable. The P-factor mainly represents how surface conditions affect flow paths and flow hydraulics. For example, with contouring, tillage marks are credited with directing runoff around the slope at much reduced grades. However, slight changes in grade can change runoff erosivity greatly. In experimental field studies, small changes in such features as row grade and their effect on erosion are difficult to document, leading to appreciable scatter in measured data. For example, the contouring effectiveness in field studies conducted on a given slope have ranged from no reduction in soil loss to a 90 percent reduction. Likewise, identifying these subtle characteristics in the field is difficult when applying the RUSLE. Thus, P-factor values represent broad, general effects of such practices as contouring.

In the RUSLE, extensive data have been analyzed to reevaluate the effect of contouring. The results have been interpreted to give factor values for contouring as a function of ridge height, furrow grade, and climatic erosivity. New P-factor values for the effect of terracing account for grade along the terrace, while a broader array of stripcropping iditions are considered in the RUSLE. inally, P factors have been developed to ect conservation practices on rangeland. e practices require estimates of surface ghness and runoff reduction. Some of the ctice values are also slope-dependent.

comparison

To illustrate some of the differences be- een RUSLE and USLE soil loss esti- ates, calculations were made for a con- uous corn field with conventional tillage ar Indianapolis, Indiana, and for range- d near Tombstone, Arizona (see table). For these illustrations, the changes in R lues are relatively insignificant. K-factor anges using the time and varying factor the RUSLE led to a smaller K value in diana and a larger value in Arizona, a nd observed frequently in our experience date. Breaking a 300-foot-long slope at ght percent into three segments (top of ope to the bottom) of 100 feet at six per- nt, 150 feet at 10 percent, and 50 feet at x percent (the same total elevation change) oduced greatly different LS values.

At the Indianapolis location, the 1.72 LS alue in the USLE increased to 1.94 in the USLE, whereas the LS value for the the USLE rangeland location decreased to .52, from 1.72, indicating the reduced rill o interrill erosion ratio on rangeland over at for cropland.

The C-factor values in both instances were ower for the RUSLE estimates when com- ared to the values from *Agriculture Hand- ook 537.* In still other instances, higher C-factor values have been observed from the RUSLE than from the USLE.

The estimated soil loss for these two illustrations are both less with RUSLE than with USLE estimates. This should not be considered the case for all locations, however.

Of greatest significance is that C-factor values can be estimated with the RUSLE for crops where SLRs were not available, that is, there were no data in tables 5 and 10 of *Agriculture Handbook 537* to cover the particular crop and operation. Given that a user can obtain data for developing a crop file to cover the specific conditions encountered in his or her climatic conditions (data to describe at intervals after planting the root mass in the upper four inches of soil, canopy cover, fall height, carbon-to-nitrogen ratio, residue-to-yield ratio, and characteristics of the residue stem), SLRs with which to calculate a C factor can be made for any crop. Furthermore, new tillage implements can be added to the operations file to cover an infinite range of activities with which to simulate their effect on soil loss.

Delivery of documentation

Drafts of the docmumentation on the RUSLE are being reviewed by technical specialists in USDA, along with other cooperators. Review of the RUSLE computer program also is nearing completion. (The programming of RUSLE is led by J. P. Porter, SCS, Flint, Michigan, formerly ARS, West Lafayett, Indiana, and Daniel Yoder and David Whittemore, ARS, West Lafayette, Indiana.) The documentation and the program should be available for widespread use in the immediate future. Close contacts with user agencies have been maintained throughout the development of RUSLE, so we feel the technology is user-oriented. The program is designed to run on a personal computer with a DOS or UNIX operating system.

Summary of RUSLE and USLE soil loss estimates for two locations

	Location			
	Continuous Corn Indianapolis, Indiana		*Rangeland Tombstone, Arizona*	
Factor	*RUSLE*	*USLE*	*RUSLE*	*USLE*
R	180	175	65	70
K*	0.32	0.37	0.32	0.26
LS†	1.94	1.72	1.52	1.72
C	0.236‡	0.252§	0.014#	0.038‖
P	1.0	1.0	1.0	1.0
A	26.4	28.1	0.44	1.19

*Used a Miami silt loam in Indianapolis and a Stronghold gravelly sandy loam in Tombstone.

†Used a 300-foot slope length at 8 percent in the USLE and a 3 segment, 100-foot at 6 percent, 150-foot at 10 percent, and 50-foot at 6 percent in the RUSLE.

‡Used continuous corn with 8-inch deep moldboard plowing on 4/10, tandem disk on 4/15, row planter on 4/20, row cultivator on 5/15, and harvest on 10/13 with 120 bushels/acre yield.

§Used continuous corn with SLRs from line 1 of table 5 in AH537.

#Used 0.8 roughness, 60 percent ground cover, 25 percent canopy cover, 4,000 pounds/acre root biomass in the upper 4 inches and a canopy height of 1-foot.

‖Used table 10 of AH537 with grass, 25 percent cover, and 60 percent ground cover.

In summary

The USLE is a powerful tool that has been used by soil conservationists for almost three decades for on-farm planning of soil conservation practices, inventorying and assessing the regional and national impacts of erosion, and developing and implementing public policy related to soil conservation. Over the last three years, a cooperative effort between scientists and users to update the USLE is nearing completion and will produce a revised version of the USLE known as the RUSLE.

Some of the improvements in the RUSLE will include:

- ► A greatly expanded erosivity map for the western United States.
- ► Minor changes in R factors in the eastern United States.
- ► Expanded information on soil erodibility.
- ► A slope length factor that varies with soil susceptibility to rill erosion.
- ► A nearly linear slope steepness relationship that reduces computed soil loss values for very steep slopes.
- ► A subfactor method for computing values for the cover-management factor.
- ► Improved factor values for the effects of contouring, terracing, stripcropping, and management practices for rangeland.

The RUSLE will be implemented using a computer program that, along with documentation, will be available soon.

Differences in soil loss estimates between the RUSLE and USLE vary from more to less erosion for individual locations depending on specific factor value changes.

REFERENCES CITED

1. El-Swaify, S. A. and E. W. Dangler. 1976. *Erodibilities of selected tropical soils in relation to structural and hydrologic parameters.* In *Soil Erosion: Prediction and Control*, Soil Cons. Soc. Am., Ankeny, Iowa. pp. 105-114.
2. Gregory, J. M., T. R. McCarty, F. Ghidey, and E. E. Alberts. 1985. *Derivation and evaluation of a residue decay equation.* Trans., ASAE 28:98-101, 105.
3. U.S. Department of Agriculture. 1982. *Basic statistics: 1977 national resources inventory.* Stat. Bull. 686. Washington, D.C.
4. Wischmeier, W. H., and D. D. Smith. 1978. *Predicting rainfall erosion losses.* Agr. Handbk. 537. U. S. Dept. Agr., Washington, D.C. ☐

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DRAFT
LOWER AREA ONE/CLARK TAILINGS DISPOSAL AREA
PHASE I, SEGMENT II
LAO EXPEDITED RESPONSE ACTION
TECHNICAL SPECIFICATIONS

Prepared for:

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January 1997

LOWER AREA ONE (LAO)/CLARK TAILINGS DISPOSAL AREA
PHASE I, SEGMENT II
LAO EXPEDITED RESPONSE ACTION
TECHNICAL SPECIFICATIONS

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SECTION 01000
GENERAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 PROGRESS SCHEDULES

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1.09 EXISTING STRUCTURES

1.10 RECORD KEEPING REQUIREMENTS

1.11 STANDARD SPECIFICATIONS

1.02 PROGRESS SCHEDULES

Contractor shall prepare an initial project schedule and shall update and maintain the schedule appropriately. Copies of all initial schedules and updates shall be provided to ARCO for review.

1.03 TEMPORARY FACILITIES AND SITE CONTROL

Contractor shall implement an appropriate program to protect the work in progress and ARCO's operations from theft, vandalism, and unauthorized entry.

Contractor shall construct temporary access roads necessary to provide unimpeded traffic for construction purposes. Contractor shall provide temporary parking areas for project personnel.

Contractor shall use only those haul roads outside of the Clark Tailings work area as specifically approved by ARCO. Contractor shall maintain all haul roads in good condition. Contractor shall provide comprehensive dust control during working and non-working hours to assure that dust levels are minimized and to comply with stated performance standards.

Contractor shall notify and coordinate with all appropriate utility companies and ARCO before conducting work proximate to overhead or buried utilities.

1.04 SURVEYING

Contractor shall provide all surveying needed to complete the work. ARCO will conduct verification surveys and quantity surveys for compensation.

1.05 SUBMITTALS

Contractor shall provide to ARCO complete product information and shop drawings where required for all materials and equipment proposed for incorporation into the project. Information shall include manufacturer, model or catalog designation, reference standards, complete installation instructions, and shop drawings that show dimensions and location of all parts. Information shall be submitted prior to ordering, and in a timely manner to provide ARCO time for review and approval.

In connection with all of the activities described in these Technical Specifications, Contractor shall be responsible and shall notify ARCO and ARCO's representatives of any governmental laws or regulations in addition to those identified in these specifications, including those relating to environmental protection and zoning, that would regulate, prohibit or control the performance by Contractor under these Technical Specifications.

1.06 TRAFFIC CONTROL AND SITE SAFETY

Traffic control and site safety shall be the sole responsibility of Contractor. Adequate signs, barricades, cones, drums, barriers, lighting, flagmen, security guards, and other methods or devices shall be utilized. For public road crossings, Contractor shall provide

the following as required by the Butte-Silver Bow Department of Public Works: traffic control; asphalt overlay for truck crossings; cleanup of spilled materials on public right-of-way; and repaving and patching of damaged public roadways.

1.07 EROSION AND SEDIMENT CONTROL

A. General

Contractor shall plan and execute work to control and minimize surface runoff from cuts, fills, and other disturbed areas. Contractor shall employ Best Management Practices (BMPs) to prevent sediment and/or sediment-laden water from entering the flow in Grove Gulch Creek to the extent practicable. BMPs shall stay in place until vegetation is established, as approved by ARCO. Contractor shall prepare and submit to ARCO an Erosion Sediment Control Plan for ARCO's approval prior to beginning site excavation or construction activities. Contractor shall obtain any necessary storm water discharge permits for construction activities from the Montana Department of Environmental Quality, Water Quality Division.

1.08 CONSTRUCTION SEQUENCING AND OTHER CONTRACTORS

Contractor shall coordinate his construction activities with those of any and all other contractors that may be working on the site. Contractor's work shall be conducted in a manner that will not impede the progress of other concurrent construction activities.

1.09 EXISTING STRUCTURES

Contractor shall be responsible for protecting existing structures within and external to the construction area. Damage to existing structures shall be corrected by the Contractor at Contractor's expense.

1.10 RECORD KEEPING REQUIREMENTS

Contractor shall maintain on-site, at all times, a complete set of all environmental health and safety documentation, Contract Documents, addenda, change orders, survey records, and other modifications to the Work. Contractor survey data and information shall be submitted to ARCO when requested.

1.11 STANDARD SPECIFICATIONS

These Technical Specifications are supplemented by the Montana Public Works Standard Specifications, Fourth Edition, January 1996 and the Standard Specifications for Road and Bridge Construction, 1995 Edition, adopted by the Montana Department of Transportation and the Montana Transportation Commission.

In performance of the Work, these Technical Specifications shall take precedence over the Standard Specifications. If, during the performance of the Work, the Contractor finds a conflict, error or discrepancy between the Technical Specifications and the Standard Specifications, the conflict, error or discrepancy shall be reported to ARCO at once, before proceeding with the affected work. The Contractor may proceed with the work only upon receiving a written interpretation or clarification from ARCO.

END OF SECTION

SECTION 02051
MONITORING WELL DISPOSITION

PART I GENERAL

1.01 SECTION INCLUDES

A. Abandonment of designated monitoring wells.

B. Preservation of designated monitoring wells.

1.02 REGULATORY REQUIREMENTS

A. Confirm with ARCO the identification, location, and proposed disposition of wells prior to beginning construction activities.

B. Disposition of monitoring wells shall be undertaken prior to construction or excavation in areas adjacent to the wells.

C. Wells to be abandoned shall be done so in accordance with the requirements set forth in Title 16, Chapter 21 of the Administrative Rules of Montana, Section 21.810, Monitoring Well Abandonment.

PART 2 PRODUCTS

2.01 SEALING MATERIALS

Bentonite, grout, or concrete products used for well abandonment shall meet the requirements of ARM 16.21.810 and shall be approved by ARCO.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect existing structures, including monitoring wells to be preserved.

3.02 DISPOSITION

A. Abandonment of Designated Monitoring Wells.

1) Perform abandonment of designated monitoring wells in accordance with the LAO Construction Drawings.

2) Remove steel caps, concrete surface plugs, and well casing of monitoring wells designated for demolition to a minimum depth of two feet below existing or final grade (whichever is lower), or as directed by ARCO.

3) Remove demolition debris from within areas of construction or excavation. Stockpile monitoring well materials from demolition on site, to transport directly to disposal area, as directed by ARCO.

4) Backfill trenches, pits, and holes resulting from demolition, and any remaining in-place well casing, to final grade using on-site materials as directed by ARCO.

B. Preservation of Designated Monitoring Wells.

1) Preserve designated monitoring wells in accordance with Drawings.

2) Raise the well casing or remove all contaminated materials from around well casing to grade indicated on Drawings, or as directed by ARCO. Use appropriate methods, including excavation by hand if needed, to remove materials without damage to remaining well casing.

3) Backfill around well casing and/or restore to final grade as directed by ARCO. Provide materials and compaction as specified for backfill adjacent to well area. Backfill around casing with compacted Type C backfill where needed to restore to grade where specific compaction of backfill is otherwise not required.

4) Restore locking steel cap, set in concrete plug, over well casing as directed by ARCO.

END OF SECTION

SECTION 02110
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of surface debris.

B. Clearing and grubbing of vegetation, including shrubs and grass.

C. Topsoil excavation.

1.02 RELATED SECTIONS

Section 02200 - Excavating.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 PROTECTION

A. Locate, identify, and protect existing utilities from damage.

B. Protect benchmarks and existing structures, including monitoring wells, from damage or displacement.

3.02 CLEARING

A. Clear areas required for access to the site and execution of the Work as shown on the Drawings and as directed by ARCO.

B. Remove identified trees, shrubs, stumps, roots, brush, rubbish, and other

objectionable material within the area to be regraded or occupied by permanent construction and from the surfaces of all borrow areas and stockpile sites.

3.03 REMOVAL

A. Remove debris, rock, and extracted vegetation and dispose of materials. All costs in connection with disposing the removed materials will be the responsibility of the Contractor.

3.04 TOPSOIL EXCAVATION/STOCKPILE

A. Topsoil is defined as the upper six inches, or deeper if identified as such by ARCO, of natural soil deposits within presently undisturbed areas or earthen materials placed as part of previous capping efforts. Contractor shall provide ARCO information necessary to determine the areas and depths of topsoil excavation. ARCO will designate areas and depths where topsoil shall be excavated.

B. Excavate topsoil from areas to be further excavated, re-capped or landscaped, or regraded.

C. Stockpile excavated topsoil such that it may be used primarily as Type G fill or Type C fill, as needed, within the work area.

END OF SECTION

SECTION 02200
EXCAVATING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Work under this section includes excavation of materials as required to form the drainage ditches shown on the Drawings; any additional cut needed to accommodate the placement of the LAO materials at the Clark Tailings; excavation of surficial tailings within the Clark Tailings work area; and any other such related excavations as may be deemed necessary by ARCO.

1.02 RELATED SECTIONS

Section 02110 - Site Clearing.
Section 02270 - Drainage Ditches.

1.03 REGULATORY REQUIREMENTS

Sheeting, Shoring, and Bracing: Except where trench banks are cut back on a stable slope, provide and maintain all sheeting, shoring, and bracing necessary to protect workers, and to protect adjoining grades and structures from caving, sliding, erosion or other damage in accordance with Occupational Safety and Health Standards 29 CFR Part 1926 - Construction Standards for Excavations; the Site Specific Health and Safety Plan; and other applicable codes and governing authorities.

1.04 FIELD MEASUREMENTS

Verify that survey benchmarks and intended reference elevations for the Work indicated on the Drawings are accurate as indicated. Notify ARCO of any discrepancies.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Accurately locate, identify, and protect from damage all utilities, benchmarks and monitoring wells not designated for demolition. Contractor must verify that all utilities through the work area have been accurately located prior to commencing any excavation activities.

C. Abandonment of designated monitoring wells shall be undertaken prior to construction or excavation in the areas adjacent to the wells.

D. Protect adjacent structures from damage by excavation work.

3.02 EXCAVATION

A. Grade top perimeter of excavation and other work areas to prevent surface runoff from draining into Grove Gulch Creek. Excavated areas shall be graded to promote surface drainage and discourage ponding prior to closure.

B. The use of explosive materials will not be permitted.

C. Excavated materials shall be reused as backfill within the site, or transported to the designated disposal area, as directed by ARCO.

D. Excavation shall conform to the boundaries, elevations and excavation slopes shown on the Drawings.

E. Remove loose material, lumped subsoil, boulders, and loose rock from excavations leaving excavation surface exposed and clean.

F. During all excavation activities, maintain and protect monitoring wells designated to be preserved (see Drawings). If any monitoring wells to be preserved are destroyed during excavation activities, they will be replaced by the Contractor at

no additional cost to ARCO.

G. If excavation impacts the landfill cap on the adjacent Old Silver Bow Landfill, the landfill cap shall be repaired at the Contractor's expense.

3.03 TOLERANCES

A. Excavate to within ±0.5 feet of elevation and location and to within ±0.1% of grade as shown on the drawings.

B. Maintain excavation dewatering sufficiently to allow for visual inspection and as-built surveying, to be conducted by ARCO at their discretion.

C. Any areas of over-excavation shall be backfilled at the Contractor's expense to the specifications listed in Section 02210 - Fill Material and Placement Requirements.

3.04 FIELD QUALITY CONTROL

A. Provide for access, visual inspection and surveying of excavation surfaces by ARCO.

B. Contractor shall perform all initial control and grade staking during construction. Final compliance and survey for payment will be verified by ARCO. Contours and elevations not meeting the requirements of the Plans and these specifications shall be corrected at the Contractor's expense.

3.05 PROTECTION

A. Protect excavations as required to prevent cave-in or loose soil from falling into excavation.

B. Notify ARCO of conditions encountered which appear unsafe in maintaining excavation as designated on Drawings.

END OF SECTION

SECTION 02210
FILL MATERIALS AND PLACEMENT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

This section specifies fill materials, borrow areas/sources of fill materials, and fill placement requirements for the following:

A. LAO tailings and other soils disposal;

B. LAO debris disposal;

C. Surficial tailings excavated from areas adjacent to the Clark Tailings Disposal Area;

D. Disposal area cap materials;

E. Runoff diversion dikes; and

F. Other miscellaneous backfill.

1.02 RELATED SECTIONS

Section 02270 - Drainage Ditches.
Section 02920 - Mulch

1.03 SUBMITTALS

Submit data sheets and test results from compliance testing of materials provided by Contractor to ARCO for review and approval.

1.04 REFERENCES

A. Sampling and Preparation

1. ASTM D75 - Standard Practice for Sampling Aggregates.
2. ASTM D420 - Recommended Practice for Investigating and Sampling Soil and Rock.

B. Classification

1. ASTM D421 - Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
2. ASTM D422 - Standard Method for Particle-Size Analysis of Soils.
3. ASTM D2487 - Classification of Soils for Engineering Purposes.
4. ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

C. Density and Moisture Content - Field

1. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
2. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).
3. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

D. Density and Moisture Content - Laboratory

1. ASTM D698 or AASHTO T99 - Test Methods for Moisture-Density

Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

2. ASTM D1557 or AASHTO T180 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

3. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.

4. ASTM D4253 - Maximum Index Density of Soils Using a Vibratory Table.

5. ASTM D4254 - Minimum Index Density of Soils and Calculation of Relative Density.

6. ASTM D4643 - Determination of Water (Moisture) Content of Soil, Microwave Oven Method.

7. ASTM D4718 - Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.

E. Hydraulic Conductivity - Laboratory

1. ASTM D5084 - Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

F. Hydraulic Conductivity - Field

1. ASTM D5093 - Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed Inner Ring.

PART 2 PRODUCTS

2.01 MATERIALS

Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

2. ASTM D1557 or AASHTO T180 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

3. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.

4. ASTM D4253 - Maximum Index Density of Soils Using a Vibratory Table.

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6. ASTM D4643 - Determination of Water (Moisture) Content of Soil, Microwave Oven Method.

7. ASTM D4718 - Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.

E. Hydraulic Conductivity - Laboratory

1. ASTM D5084 - Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

F. Hydraulic Conductivity - Field

1. ASTM D5093 - Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed Inner Ring.

PART 2 PRODUCTS

2.01 MATERIALS

A. Type C Fill: Imported clean backfill for excavated areas and to maintain positive drainage from the site. Also the initial 12" lift of cover soil over Type L fill. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
6-inch average diameter	100
#200 sieve	5-20

B. Type G Growth Media: Imported soil to be placed as growth media in the Clark Tailings Disposal Area and other areas as shown on the Drawings. The material shall be free from debris, rocks, roots, and deleterious or objectionable materials. This material shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	85-100
#4	50-90
#40	20-50
#200	10-40

C. Type H Fill: Debris and oversize materials removed from LAO to be disposed at the Clark Tailings Disposal Area as shown on the Drawings.

D. Type I Fill: Mine wastes and associated soils removed from LAO or areas adjacent to the Clark Tailings Disposal Area to be disposed at the Clark Tailings Disposal Area. The materials generally consist of well graded sands with silt (SW-SM) to silty sands (SM).

E. Type J Fill: The uppermost (6-inch) lift of mine wastes and associated soils from LAO disposed at the Clark Tailings disposal area. This material shall be free of debris and deleterious or objectionable materials. The material used for Type J fill shall be meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
#200	10-50

F. Type K Fill: Generally fine-grained materials removed from LAO to be placed as the infiltration barrier layer in the Clark Tailings Disposal Area cap as shown of the Drawings. The materials shall be native silts and silty sands with some organics. The material shall be approved by ARCO for use as Type K fill and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	94
#4	90
#40	50
#200	30-70

Type K fill shall be separated from other materials (such as tailings) to the extent feasible using standard excavating procedures and equipment during removal from LAO. While no mechanical separation or screening shall be required, Type K materials should be excavated, loaded, and transported to the Clark Tailings Disposal Area separately from Types H, I, and J fill.

G. Type L Fill: Generally fine-grained materials from the Hollow borrow pit north of the Clark Tailings to be placed as the infiltration barrier layer (as an alternative to Type K fill) in the Clark Tailings Disposal Area cap as shown of the Drawings. The materials shall be native clayey sands. The material shall be approved by ARCO for use as Type L fill and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	98
#4	90
#40	45

#200	25-70

G. Type M Fill: Imported granular material to be placed as the capillary break materials in the Clark Tailings Disposal Area cap as shown on the Drawings. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
.3/4-inch	10-30
#200	0-10

2.02 SOURCE QUALITY CONTROL

A. Tests and analyses of soil materials will be performed in accordance with applicable ASTM test methods, as listed under Part 1.04.

B. If tests indicate materials do not meet specified requirements, change material and retest at no cost to ARCO.

C. Compliance testing will be performed by ARCO at their discretion.

PART 3 EXECUTION

3.01 SOURCE OF MATERIALS

A. Obtain Type H Fill, Type I Fill, Type J Fill, and Type K Fill from the LAO excavation.

B. Contractor shall notify ARCO which source of Type C Fill, Type G Growth Media, Type L Fill, Type K Fill, and Type M Fill. Type C and Type G Growth Media may be obtained from borrow areas within 1.5 miles of the Clark Tailings Disposal Area. Type M fill may be hauled from a borrow pit near Crackerville, Montana.

3.02 BORROW SOURCE GRADING/RECLAMATION

Contractor shall grade and prepare final borrow source surfaces for seeding as described in borrow source specific reclamation requirements provided by ARCO.

3.03 PREPARATION FOR PLACEMENT

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect utilities that remain from damage, including all monitoring wells not designated for demolition. Notify utility companies for utilities which may be affected by the work, or which cross the work area.

D. Protect bench marks and existing structures from excavating equipment and vehicular traffic.

E. Compact subgrade or existing underlying fill to a minimum depth of 12 inches to meet density requirements for subsequent fill materials as specified in Part 3.05.

F. Cut out soft areas of subgrade or existing underlying fill that cannot be compacted as specified in paragraph E, above. Backfill with material type specified for subsequent fill, and compact to minimum density requirements for subsequent fill material as specified in Part 3.05.

G. Dewater area as needed prior to fill placement. Fill may not be placed if groundwater is present.

3.04 PLACEMENT

A. Debris (Type H Fill): Debris shall be placed at two locations in the Clark Tailing Disposal Area.

   1. Incorporating Debris into Tailings and Other Soils Fill Placement: Debris that does not exceed a maximum dimension of 3 feet shall be distributed

evenly throughout areas of non-structural fill placement, as shown on the Drawings. Debris shall not be concentrated in one or more areas, and shall be spread throughout the fill so that no debris objects are be in contact with one another.

2. Designated disposal location: Contractor shall dispose of large debris (greater than 3 feet in diameter), or other debris specifically selected by ARCO, in the designated disposal locations shown on the Drawings. Large voids within the debris shall be filled with tailings or other soils as directed by ARCO.

B. Tailings and Other Soils (Types I and J Fill)

1. Maintain positive surface drainage to avoid ponding of water on fill.

2. All surfaces upon or against which fill will be placed, including previously placed and compacted layers shall be clean of all objectionable materials, shall be moist but free of standing or ponded water; and shall be scarified as necessary, so as to provide a suitable bond between the existing and newly placed material.

3. Place fill with maximum 12 inch lift thickness before compaction.

4. The uppermost 6 inches (compacted) of tailings material (Type J fill) shall be placed in one lift over the portion of the Clark Tailings Disposal Area impacted by the placement of LAO materials to the line and grade shown on the Drawings or as directed by ARCO.

5. Fill material requiring compaction shall not be frozen when placed. Material shall not be placed on ice or frozen material.

6. Fill materials shall be placed such that the maximum finished slope is 4 horizontal:1 vertical.

C. General Fill to Maintain Drainage

1. General fill to maintain drainage in areas outside of the Clark Tailings Disposal Area (Type C Fill) shall be placed in lifts not to exceed 3 feet in loose thickness. Thinner lifts must be used if necessary to achieve the compaction specification in Part 3.05.

2. Finish grade to within ±0.3 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO.
3. Maintain positive surface drainage to minimize ponding of water on the fill.

4. Material shall not be frozen when placed. Material shall not be placed on ice or frozen material.

D. Infiltration Barrier Materials

1. All surfaces upon which infiltration barrier materials will be placed shall be free of all objectionable materials, as determined by ARCO, in accordance with Section 02110 - Site Clearing. Surfaces shall be free of standing water and shall be scarified as necessary so as to provide a suitable bond between the underlying materials and the infiltration barrier materials, particularly on side slopes.

2. Place infiltration barrier materials (Type K and Type L fill) in lifts not to exceed 9 inches in loose thickness or 6 inches compacted thickness. Thinner lifts shall be required if necessary to achieve the compaction criteria presented in Part 3.05.

3. Finish grade to within ±0.3 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO.

4. Maintain positive surface drainage to minimize ponding of water on the fill.

5. Material shall not be frozen when placed. Material shall not be placed on ice or frozen material.

E. Capillary Break Materials

1. Place capillary break materials (Type M Fill) in one lift of 6-inches loose thickness.
2. Finish grade to within ±0.3 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO.
3. Type M material shall be transported and placed so as to minimize the migration of fine-sized particles into void spaces. This material shall not be pushed more than 100 feet nor end dumped higher than 10 feet to maintain proper size distribution.

F. Cover Soil and Growth Media

1. Place cover soil (Type C Fill) and growth media (Type G) in lifts not to exceed 12 inches and 6 inches, respectively, in loose thickness.
2. Finish grade to within ±0.3 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO.
3. Maintain positive surface drainage to minimize ponding of water on the fill.
4. Material shall not be frozen when placed. Material shall not be placed on ice or frozen material.
5. Cover soil and Growth Media shall be mulched in accordance with Section 02920 to provide temporary erosion control after finished-grade has been achieved and approved by ARCO.

3.05 COMPACTION

A. Debris

1. Debris Incorporated in Tailings and Contaminated Soils Fill Placement:

1. Debris shall be crushed and reduced in size to the extent possible prior to covering with fill. Voids within debris disposal areas will be filled with tailings or other soils to minimize void space as directed by ARCO.

2. Designated disposal location: Debris shall be crushed and reduced in size to the extent possible prior to placement in the fill area. Debris in disposal area shall be compacted to the extent possible in lifts not to exceed 3 feet thick to minimize future settlement of the fill.

B. Tailings and Contaminated Soils Placed in Structural Fill Areas and the Uppermost Lift (Type J Fill) in Non-Structural Fill Areas

1. Moisture Content: The moisture content, as determined by ASTM D2216, shall be between plus 2 percent and minus 2 percent of the optimum moisture content as determined by ASTM D698. The moisture content shall be uniform throughout the lift.

2. Density

   a. Materials containing less than 5 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 90 percent of the maximum index density as determined by ASTM D4253.

   b. Materials containing greater than 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 95 percent of the maximum index density as determined by ASTM D698.

   c. Materials containing 5 to 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted in accordance with either specification a. or b. above at the discretion of ARCO.

C. Tailings and Contaminated Soils Placed in Non-Structural Fill Areas

1. Density

   a. Materials containing less than 5 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 85 percent of the maximum index density as determined by ASTM D4253.

   b. Materials containing greater than 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 90 percent of the maximum index density as determined by ASTM D698.

   c. Materials containing 5 to 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted in accordance with either specification a. or b. above at the discretion of ARCO.

D. General Fill to Maintain Drainage

Density: Type C materials shall be compacted sufficiently to support traffic by construction equipment.

E. Infiltration Barrier Materials (Type K and L Fill)

1. Moisture Content: The moisture content, as determined by ASTM D2216, shall be between 0 to +4% of the optimum moisture content as determined by ASTM D698. The moisture content shall be uniform throughout the lift. Placed materials not meeting this requirement, as determined by testing by ARCO, shall be scarified to the depth of the lift in question, wetted or dried as necessary to meet this requirement, and mixed to a uniform water content.

2. Density: Materials shall be compacted to the density required to attain a minimum hydraulic conductivity of 1 x 10^{-5} cm/sec. Based on laboratory testing conducted to date, it is anticipated that the materials must be compacted to 95% of the maximum dry density as determined by ASTM

D698. The compaction required to meet the hydraulic conductivity specification will be verified by ARCO through in situ hydraulic conductivity testing prior to construction. Based on the results of the in situ testing, the actual compaction specification for these materials may be less than or greater than 95% of the maximum dry density as determined by ASTM D698.

F. Capillary Break Materials (Type M Fill)

Density: Capillary break materials shall be compacted sufficiently to support traffic by construction equipment.

G. Cover Soil and Growth Media

Cover soil and growth media shall be placed as loose as possible to promote vegetative growth.

3.06 SITE GRADING

Grade all areas including excavated, filled, and transition areas to obtain the finished surface shown on Drawings, to the tolerances specified in Part 3.04 above. Finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. Finished surfaces shall have positive drainage to minimize ponding of water. After the finished surface has been approved by ARCO, mulch shall be applied (with the exception of those areas to be covered with erosion control mat) in accordance with Section 02920 to provide temporary erosion control.

3.07 FIELD QUALITY CONTROL

A. Testing for compaction control and gradation will be conducted by ARCO. Embankment not meeting the requirements of these specifications shall be corrected at no additional expense to ARCO.

B. Contractor shall perform all initial control and grade staking during construction. Final compliance and survey for payment will be verified by ARCO. Contours

and elevations not meeting the requirements of these specifications shall be corrected at the Contractor's expense.

END OF SECTION

SECTION 02270
DRAINAGE DITCHES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Work under this section includes construction of the drainage ditches shown on the Drawings.

1.02 RELATED SECTIONS

Section 02110 - Site Clearing.
Section 02200 - Excavation.
Section 02210 - Fill Materials and Placement Requirements.
Section 02710 - Geosynthetic Materials.
Section 02910 - Dryland Seeding and Fertilizing.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, cross sections, and datum.

B. Accurately locate, identify, and protect from damage all utilities, benchmarks and monitoring wells not designated for demolition. Contractor must verify that all utilities through the work area have been accurately located prior to commencing any excavation activities.

3.02 EXCAVATION

A. All excavation shall be conducted in accordance with Section 02200 - Excavation.

B. Grade channels to subgrade to the lines, grades and cross sections shown on the Drawings.

C. Excavated materials shall be reused as backfill within the site, or transported to the designated disposal area, as directed by ARCO.

D. Remove loose material, lumped subsoil, boulders, and loose rock from excavations leaving excavation surface exposed and clean.

E. Place cover materials as specified on the Drawings and in accordance with Section 02210 - Fill Materials and Placement Requirements.

F. Upon approval of finish grade by ARCO, all ditches shall be seeded and fertilized as specified in Section 02910 - Dryland Seeding and Fertilizing.

G. Following application of seed and fertilizer, erosion control mat shall be installed in accordance with Section 02710 - Geosynthetic Materials.

3.03 TOLERANCES

A. Invert elevation of drainage ditches shall be constructed to within ±0.3 feet of elevation and location and to within ±0.1% of grade as shown on the Drawings.

C. Any areas of over-excavation shall be backfilled at the Contractor's expense to the specifications listed in Section 02210 - Fill Material and Placement Requirements.

3.04 FIELD QUALITY CONTROL

A. Provide for access, visual inspection and surveying of excavation surfaces by ARCO.

B. Contractor shall perform all initial control and grade staking during construction. Final compliance survey for Payment will be verified by ARCO prior to seeding,

fertilizing and erosion control mat installation. Contours and elevations not meeting the requirements of the Plans and these specifications shall be corrected at the Contractor's expense.

END OF SECTION

SECTION 02710
GEOSYNTHETIC MATERIALS

PART I GENERAL

1.01 SECTION INCLUDES

This section includes product specifications for geotextile materials, storage and handling guidelines, and installation procedures for the following:

A. Erosion control mat.

1.02 RELATED SECTIONS

Section 02200 - Excavation.
Section 02270 - Drainage Ditches.
Section 02910 - Dryland Seeding and Fertilizing.

1.03 SUBMITTALS

Submit the following to ARCO:

A. Product Data: Submit catalog data and installation instructions for materials specified herein and proposed for use.

B. Certificates of Compliance: Furnish certification that standards specified herein are met.

PART 2 PRODUCTS

2.01 EROSION CONTROL MAT

Erosion control mat used for channel lining shall be a machine-produced mat of 100% coconut fiber. The mat shall be of consistent thickness with the coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom with black polypropylene netting having ultraviolet additives to reduce breakdown and an opening size adequate to maintain uniformity in the mat. The mat

shall be sewn together with polyester threads spaced at 1.5" centers or less.

Erosion control mat shall be model C125 as manufactured by North American Green, 14649 Highway 41, North Evansville, IN 47711, (800) 772-2040 and distributed by Roscoe Steel & Culvert Company, 5405 Momont Road, Missoula, MT 59802, (406) 542-0345, or equivalent, as approved by ARCO.

2.02 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaging: Each roll of geosynthetic material shall be packaged individually with suitable wrapping to protect the material during normal storage and handling, from damage due to ultraviolet light, and moisture.

B. Labeling: Each roll shall be identified by a tag or label securely affixed to the outside of the roll on one end. The label shall include the manufacturer or supplier, the style number and the roll number.

C. Storage: Store all geosynthetic materials elevated off the ground and ensure that they are adequately covered.

D. Geosynthetics damaged during transport, storage or placement shall be replaced at no expense to ARCO.

PART 3 EXECUTION

3.01 SITE PREPARATION

The channel to be covered by the erosion control mat shall be graded to a smooth condition free from protruding objects such as rocks, sticks and other debris. Wheel ruts, footprints, or undulations allowing separation of erosion control mat from the surface by more than 2 inches must be graded smooth before installation. Prior to placing the mat, the channel shall be seeded and fertilized in accordance with Section 02910.

3.02 INSTALLATION

The erosion control mat shall be installed in strict accordance with the manufacturers recommendations for channel installations and according to the following:

1. Blankets shall be placed end over end (shingle style) with a 6 inch overlap. Blankets shall be placed so as to conform to the underlying terrain prior to stapling. Blankets shall not be stretched. A double row of staggered staples 4 inches apart shall be used to secure the rolls.

2. Installation shall occur starting at the top of the channel by anchoring the blanket in a 6 inch deep by 6 inch wide trench. Trench shall be backfilled after stapling.

3. Blankets on side slopes shall overlap center blanket a minimum of 4 inches and shall be anchored at the top of slope in a 6 inch by 6 inch anchor trench.

4. The terminal end of the blankets must be anchored in a 6 inch by 6 inch trench. The trench shall be backfilled and compacted after stapling.

3.03 REPAIRS AND SPECIAL INSTALLATION

A. The erosion control mat shall be installed so as not to significantly disturb the seedbed. If the seedbed is seriously disturbed, ARCO may require re-preparing and reseeding at no additional cost to ARCO.

B. Should the erosion control mat be torn or otherwise damaged, the damaged area shall be repaired or replaced to manufacturer's specifications by the contractor at no cost to ARCO.

END OF SECTION

SECTION 02720
GEOSYNTHETIC CLAY LINER

PART I GENERAL

1.01 SECTION INCLUDES

This section includes product specifications for geomembrane materials, storage and handling guidelines, and installation procedures for the following:

A. Geosynthetic Clay Liner (GCL).

1.02 RELATED SECTIONS

Section 02110 - Site Clearing.
Section 02200 - Excavation.
Section 02210 - Fill Materials and Placement Requirements

1.03 SUBMITTALS

Submit the following to ARCO:

A. Conceptual description of the proposed plan for placement of the GCL panels over the prepared area of installation.

B. GCL manufacturer's MQC Plan for documenting compliance to Sections 2.02 and 2.03 of these specifications.

C. At the Engineer's or Owner's request:

1. A representative sample of the GCLs.
2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million square feet in size.

D. Upon shipment, the Contractor shall furnish the GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.

E. As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and CQA Inspector (See Section 1.04) for each area that is covered by the GCL.

1.04 CONSTRUCTION QUALITY ASSURANCE (CQA)

A. ARCO will provide an independent inspector for CQA of the GCL installation. The CQA Inspector will be responsible for monitoring and documenting activities related to the CQA of the GCL, throughout installation.

B. Testing of the GCL, as necessary to support the CQA effort, shall be performed by a laboratory independent from the GCL manufacturer and installer.

PART 2 PRODUCTS

2.01 GEOSYNTHETIC CLAY LINER

A. The GCLs shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and shall comply with all of the criteria listed in this Section. Prior to using an alternate GCL, the Contractor must furnish independent test results demonstrating that the proposed alternate material meets all requirements of this specification. The Contractor also must obtain prior approval of the alternate GCL by the Project Engineer.

B. Reinforced GCL must be used on slopes as designated by the Engineer. Unreinforced GCL may be used on flat areas of the site not exceeding 10H:1V in steepness.

2.02 MATERIALS

A. The GCL shall be Bentomat® ST as manufactured by CETCO, 1350 West Shure Drive, Arlington Heights, Illinois 60004 USA (708-392-5800), or an ARCO-approved equivalent.

B. The GCL(s) and their components shall have the following properties:

MATERIAL PROPERTY	TEST METHOD	REQUIRED VALUES[1]
Bentonite Free Swell	USP / NF XVII	24 mL/2g min.
Bentonite Fluid Loss	API 13A/13B	18 mL max.
Bentonite Mass/Area	ASTM D 5261	0.95 lbs/ft^2 (4.6 kg/m^2)
GCL Grab Strength[2]	ASTM D 4632	90 lbs (400 N)
GCL Grab Elongation	ASTM D 4632	15 percent typical
GCL Peel Strength	ASTM D 4632	15 lbs (65 N)
GCL Permeability[3]	ASTM B 5084	5 x 10^{-9} cm/sec
GCL Hydrated Internal Shear Strength[4]	ASTM D 5321	500 psf (24 kPa) typical

Notes:

[1] All Values minimum average roll values unless otherwise indicated.

[2] Tensile testing performed in the machine direction.

[3] Permeability with deaired distilled water at 5 psi (35 kPa) confining pressure and 2 psi (15 kPa) head pressure.

[4] Peak value measured at 200 psf (30 kPa) normal stress. Site-specific materials, GCL products, and test conditions must be used to verify internal and interfacial stability of the proposed design.

C. The minimum acceptable dimensions of full-size GCL panels shall be 13.8 feet (4.2 m) in width and 125 feet (38 m) in length. Short rolls [those manufactured to a length greater than 70 feet (21 m) but less than a full-length roll] may be supplied at a rate no greater than 3 per truckload or 3 rolls every 36,000 square feet (500 m^2) of GCL, whichever is less.

D. A 6-inch (150 mm) overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

2.03 PRODUCT QUALITY DOCUMENTATION

The GCL manufacturer shall provide ARCO or ARCO's representatives with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

A. Certificates of analysis for the bentonite clay used in GCL production demonstrating compliance with the parameters in Section 2.02.

B. Test data for geotextile materials used in GCL production, including, at a minimum, mass/area and tensile test data demonstrating compliance with the GCL manufacturer's MQC plan.

C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

D. Manufacturer's test data for the finished GCL product, including the parameters of bentonite mass/area, tensile strength, and representative permeability data demonstrating compliance with the performance parameters shown in Table 1.

2.04 PRODUCT LABELING

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand name, product code).

2. Lot number and roll number.

3. Roll length, width and weight.

2.05 PACKAGING

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

2.06 ACCESSORY BENTONITE

A. The granular bentonite or bentonite sealing compound used for seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer.

PART 3 EXECUTION

3.01 SHIPPING AND HANDLING

A. The manufacturer assumes responsibility for initial loading of the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor, Installer or other designated party.

B. A visual inspection of each roll should be made by the Contractor during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

C. The Contractor should contact the GCL Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

3.02 Storage

A. Storage of the GCL rolls shall be the responsibility of the Contractor. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well- drained.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks or by use of the dunnage shipped between rolls. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

D. The integrity and legibility of the labels shall be preserved during storage.

E. Any GCL that is visibly damaged or wetted during storage shall not be used and shall be replaced at the Contractor's expense.

3.03 Earthwork

A. Any earthen surface upon which the GCL is installed shall be prepared and compacted in accordance with the project specifications and drawings. The surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation.
2. Construction Debris.
3. Sticks.
4. Sharp rocks.
5. Void spaces.
6. Ice.
7. Abrupt elevation changes
8. Standing water
9. Cracks larger than one-quarter inch (6 mm) in width
10. Any other foreign matter that could contact the GCL.

B. Subgrade surfaces consisting of granular soils or gravel are not acceptable. Subgrade soils should possess particles with extruding greater than 3/4-inch.

C. Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularity shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.

D. On a continuing basis, ARCO or ARCO's representative shall certify acceptance of the subgrade before GCL placement.

E. It shall be the installer's responsibility thereafter to indicate to the Engineer any change in the condition of the subgrade that could cause the subgrade to be out of

compliance with any of the requirements listed in this Section.

F. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated in accordance with the project plans. The trench shall be excavated and approved by the CQA Inspector prior to GCL placement. No loose soil shall be allowed at the bottom the trench and no sharp corners or protrusions shall exist anywhere within the trench.

3.04 GCL Placement

A. GCL rolls should be delivered to the working are of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the Engineer's or Manufacturer's recommendations. Unless otherwise specified, however, the GCL shall be installed such that the product name printed on one side of the GCL faces up.

B. Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

C. Care must be taken to minimize the extent which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

D. The GCL shall be placed so that seams are parallel to the direction of the slope. Seams should be located at least 3 feet (1 m) from the toe and crest of slopes steeper than 4H:1V.

E. All GCL panels should lie flat underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

F. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project Engineer, CQA inspector, and GCL supplier should be consulted for specific guidance if premature hydration occurs.

G. As directed by the project drawings, the end of the GCL roll shall be placed in an anchor trench at the top of the slope. The front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor but the rear trench wall.

3.05 Seaming

A. The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required if the GCL has one or more non-woven needlepunched geotextiles.

B. The minimum dimension of the longitudinal overlap shall be 6 inches (150 mm). End-of-roll seams shall be overlapped a minimum of 12 inches (300 mm).

C. Seams at the ends of the panel should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

D. Bentonite-enhanced seams are constructed by overlapping adjacent panels as instructed above, exposing the underlying edge, and then applying a continuous bead of granular sodium bentonite along a zone defined by the edge of the underlying panel and the 6-inch (150 mm) line. The bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).

3.06 Detail Work

A. The GCL shall be sealed with bentonite around penetrations and embedded structures embedded in accordance with the design drawings and the GCL Manufacturer.

B. Cutting the GCL should be preformed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.07 Damage Repair

A. If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all of the damaged area. Dry bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

3.08 Cover Placement

A. Cover soils shall be free of angular stones or other foreign matter which could damage the GCL. Cover soils should be approved the project Engineer with respect to particle size, uniformity and chemically compatibility. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.

B. Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover shall be maintained between the equipment tires/tracks and the GCL at all times during the covering process. For frequently trafficked areas or roadways, a minimum cover thickness of 2 feet (600 mm) is required.

C. Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. The Contractor shall place the soil in a manner that does damage the GCL.

END OF SECTION

SECTION 02910
DRYLAND SEEDING AND FERTILIZING

PART I GENERAL

1.01 SECTION INCLUDES

The work described in this section shall consist of providing all labor, services, seed, fertilizer, and equipment to seed and establish grasses in the drainage channels.

1.02 RELATED SECTIONS

Section 02200 - Excavation.
Section 02270 - Drainage Ditches.
Section 02710 - Geosynthetic Materials.

1.03 SUBMITTALS

Submit the following to ARCO:

A. Certificates of Compliance: Furnish certification that standards specified herein are met and provide all seed tags to ARCO.

PART 2 PRODUCTS

2.01 GRASS SEED

Grass seed shall be a mixture of the species and variety specified below. The seed mix shall be as follows:

SPECIES	APPLICATION RATE (lbs pure live seed per acre)
Agropyron smithii (Western wheatgrass)	18
Agropyron spicatum (Bluebunch wheatgrass)	12
Bouteloua gracilis (Blue grama)	4
Oryzopsis hymenoides (Indian ricegrass)	16

In addition, 24 pounds per acre of REGREEN™ or equal non-native annual grass shall be applied.

Seed shall comply with and be labeled in accordance with the Montana Seed Law and shall be free of all prohibited noxious weed seed or any other weed seed prohibited by state of local ordinance. Seed shall have been grown in the North American Continent above 41 degrees latitude. All seed shall be standard grade adapted to Montana conditions.

2.02 FERTILIZER

Urea fertilizer (46:0:0 N:P:K) shall be applied at a rate of 120 pounds per acre (equivalent of 50 pounds per acre of nitrogen).

2.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Storage: Store all seed and fertilizer properly. Any seed or fertilizer damaged during such storage shall be replaced by the Contractor at his expense.

PART 3 EXECUTION

3.01 TIME OF SEEDING

The seeding shall be conducted prior to June 1 or after October 15, unless otherwise approved by ARCO.

3.02 PREPARATION OF SEEDBED

After finish grading is approved by ARCO, all channel slopes to receive seed shall be raked to true lines, free from large humps, ridges and depressions.

3.03 SEEDING

Seeding for the drainage channels shall be done by broadcast methods at the rates specified above.

3.04 FERTILIZING

Fertilizer shall be applied concurrently with the seed using broadcast methods at the specified rates.

3.05 EROSION CONTROL MAT

Erosion control mat shall be installed immediately after seeding in accordance with Section 02710.

3.06 ESTABLISHMENT

A. The Contractor shall be responsible for the proper care and maintenance of the seeded areas during the period of construction.

B. Repair - If at any time before completion and acceptance of the entire work covered by this contract, any portion of the channel surface becomes gullied or otherwise damaged following seeding and erosion control mat installation, the affected portion shall be repaired to re-establish the condition and grade of the soil prior to seeding and shall then be reseeded and new erosion control mat installed at the Contractor's expense.

END OF SECTION

SECTION 02920
MULCH

PART I GENERAL

1.01 SECTION INCLUDES

This section includes product specifications for covering and processing specified seeded areas with vegetative mulch.

1.02 RELATED SECTIONS

Section 02910 - Dryland Seeding and Fertilizing

1.03 SUBMITTALS

Submit the following to ARCO:

A. Manufacturer/Supplier's specifications and material content for mulch products.

B. Manufacturer/Supplier's recommended application methods and rate.

C. "Weed Seed Free" Certification.

PART 2 PRODUCTS

2.01 VEGETATIVE MULCH

The type of mulch material used shall be composed of wheat straw, rye straw, or barley straw.

A. Straw mulch shall be clean grain straw, shall be "Montana Noxious Weed Seed Free" straw and shall not contain greater than 5% cereal seed by weight (i.e., seed heads). Written confirmation from a certified supplier will be required.

RECEIVED

7 FPC

JAN 2~~4~~ 1997

MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

DRAFT
CONSTRUCTION QUALITY ASSURANCE PLAN FOR THE CLARK TAILINGS WASTE MANAGEMENT AREA

Prepared for:

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

January 1997

PIONEER
TECHNICAL SERVICES, INC.

P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

100% post-consumer paper & 100% vegetable based inks

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January 1997

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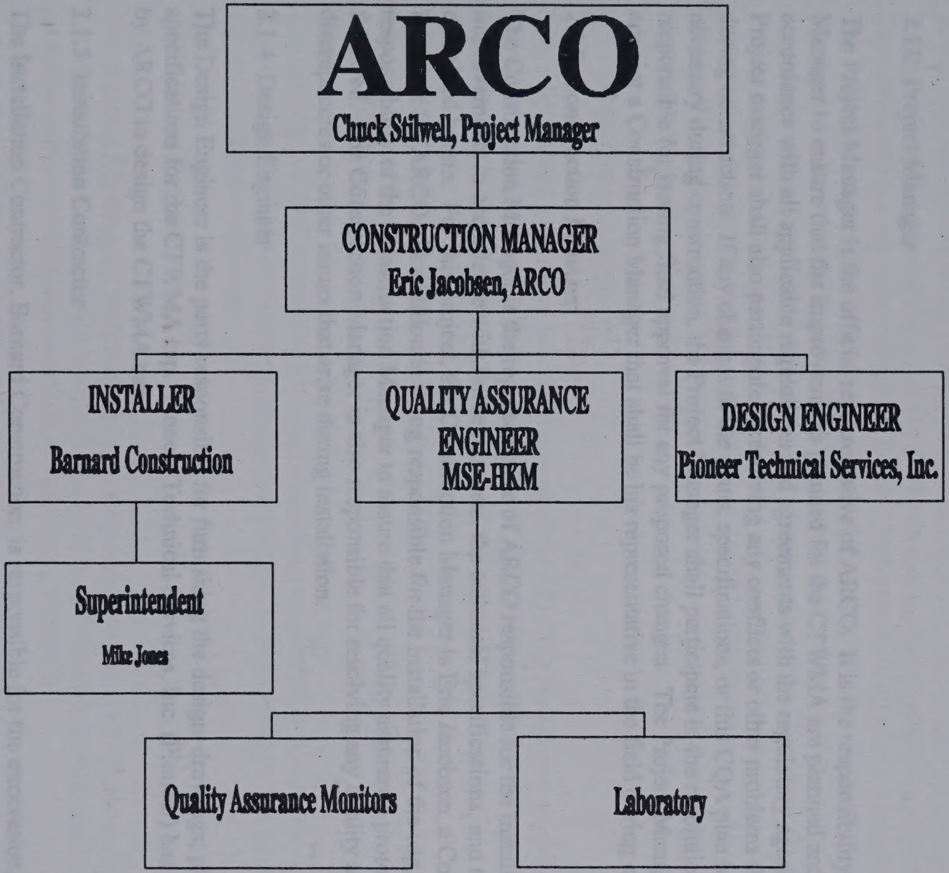

ARCO
Chuck Stilwell, Project Manager
CONSTRUCTION MANAGER
Eric Jacobsen, ARCO
INSTALLER
Barnard Construction
QUALITY ASSURANCE ENGINEER
MSE-HKM
DESIGN ENGINEER
Pioneer Technical Services, Inc.
Superintendent
Mike Jones
Quality Assurance Monitors
Laboratory

PIONEER TECHNICAL SERVICES, INC.

FIGURE 2-1

CTWMA CONSTRUCTION ORGANIZATION CHART

SCALE: NTS
DATE: 12/19/96

2.1.1 Owner/Operator

Ownership of the CTWMA is currently being transferred to Butte-Silver Bow (BSB) from Inland Properties. Under an agreement between the Atlantic Richfield Company (ARCO) and BSB, ARCO is the Operator of the CTWMA for this project (placing LAO materials and constructing the cap and ancillicary improvements at the CTWMA). The Project Manager and Construction Manager are the official representatives of ARCO.

2.1.2 Project Manager

The Project Manager is the official representative of ARCO. It is the responsibility of the Project Manager to ensure that the improvements planned for the CTWMA are planned and conducted in accordance with all applicable regulations and agreements with the regulatory agencies. The Project manager shall also participate is resolving any conflicts or other problems that arise during construction. If any changes to the plans, specifications, or this CQA plan become necessary during construction, the Project Manager shall participate in the resolution and shall be responsible for issuing final approval for any proposed changes. The Project Manager shall appoint a Construction Manager that shall be his representative in the field during construction.

2.1.3 Construction Manager

The Construction Manager is the representative of ARCO responsible for the installation of the improvements in accordance with the regulations, the technical specifications, and the provisions contained herein. For this project, the Construction Manager is Eric Jacobsen, a Construction Engineer for ARCO. In addition to being responsible for the installation of the cap, it is the responsibility of the Construction Manager to assure that all quality assurance protocols are followed. The Construction Manager is also responsible for resolving any quality assurance discrepancies or other issues that arise during installation.

2.1.4 Design Engineer

The Design Engineer is the party responsible for furnishing the design, drawings, plans, and specifications for the CTWMA cap. Pioneer Technical Services, Inc. (Pioneer) has been retained by ARCO to design the CTWMA cap.

2.1.5 Installation Contractor

The Installation Contractor, Barnard Construction, is responsible for the excavation, transport, and installation of the materials comprising the cap in accordance with the specifications and the provisions contained herein and any site specific variations to the plan as required by the Quality Assurance Engineer. The Installation Contractor will identify a Superintendent who will be responsible for the field crew, including laborers and equipment operators. The Superintendent will communicate to the Quality Assurance Engineer regarding progress, difficulties encountered, and any variations from the installation plan. The Installation Contractor's duties

include the following: grading; surveying for grade and cover thickness control; moisture control for materials installation; transporting, placing, and compacting cap materials; final grading; providing and incorporating soil amendments; and fertilizing, seeding, and mulching.

2.1.6 Quality Assurance Engineer

MSE-HKM will serve as the Quality Assurance contractor for ARCO. MSE-HKM shall identify a lead engineer to serve as the Quality Assurance Engineer. The Quality Assurance Engineer will be responsible for certifying that the CTWMA cap has been installed in accordance with the regulations and the provisions contained herein. Furthermore, the Quality Assurance Engineer is the individual responsible for observing, testing, and documenting activities related to the quality assurance for the installation of the CTWMA cap and will work on behalf of the Construction Manager to ensure compliance with the quality assurance program contained herein. The Quality Assurance Engineer may be assisted by Quality Assurance Monitors who would provide construction observation, testing, and documentation. The Quality Assurance Engineer will employ the services of a qualified soils testing laboratory to conduct the soils analyses required by this plan.

2.1.7 Soils Testing Laboratory

The Soils Testing Laboratory is a laboratory hired by ARCO or the Quality Assurance Engineer to perform quality assurance soils tests. The term "Laboratory" is used to denote the official representative of the Soils Testing Laboratory throughout this plan.

2.2 RECOMMENDED PERSONNEL QUALIFICATIONS

2.2.1 Construction Manager

The selection of the Construction Manager is the direct responsibility of ARCO. The Construction Manager should be experienced in overseeing large earthmoving projects and the placement of native soil caps.

2.2.2 Design Engineer

The engineer representing the Design Engineer must be a Professional Engineer with the State of Montana and qualified to design a soil cap that fulfills ARCO's operational requirements and complies with accepted design practices and regulatory standards.

2.2.3 Installation Contractor

The Installation Contractor will be experienced in soil cap construction and knowledgeable about low permeability soil cap construction techniques.

2.2.4 Quality Assurance Engineer

The Quality Assurance Engineer should be a Professional Engineer licensed in the State of Montana with experience in geotechnical engineering, construction, and interpretation of the results of field and laboratory testing. The Quality Assurance Engineer should have a history which demonstrates familiarity with soil cap components and construction techniques which includes soil design methods and procedures.

2.2.5 Soils Testing Laboratory

The Soils Testing Laboratory will have experience in testing soils and will be familiar with American Society for Testing and Materials (ASTM) and other applicable test standards. The Soils Testing Laboratory is responsible for ensuring that tests are performed in accordance with applicable methods and standards, for following internal quality control procedures, for maintaining sample chain-of-custody records, and for reporting data. This Soils Testing Laboratory must also be responsive to the testing needs of the project by providing test results within a reasonable time.

2.3 PROJECT MEETINGS

To attain a high degree of quality during facility construction, clear and open channels of communication are essential. To maintain communications throughout construction, specific meetings will be held. These meetings are detailed in the following subsections.

2.3.1 Preconstruction Meeting

Prior to commencing construction of each major phase at the CTWMA, a preconstruction meeting shall be held. This meeting will include the parties involved in the construction, including the Project Manager, Construction Manager, Design Engineer, Installation Contractor, and the Quality Assurance Engineer.

The purpose of this meeting is to establish lines of communication, review construction plans and specifications, emphasize the critical aspects of a project necessary to ensure proper quality, begin planning and coordination of tasks, anticipate any problems that might cause difficulties or delays in construction, and above all, to present the CQA Program to all parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by each party to this Program.

Specific topics considered for this meeting include the following:

- Review critical design of the project, including the plans and CQA Program;

- Make appropriate modifications to the CQA Program and develop any task-specific addenda;
- Review the responsibilities of each party;
- Review lines of authority and communication;
- Review methods for documenting and reporting and for distributing documents and reports;
- Discuss corrective actions to resolve potential construction problems;
- Review the number and locations of the testing requirements;
- Review precautions to be taken to maximize bonding between lifts of compacted low permeability soil;
- Review precautions to be taken to minimize desiccation cracking of low permeability soil surfaces;
- Review methods of low permeability soil layer surface preparation and approval prior to cover soil placement;
- Review the construction work plan developed by the installation contractor;
- Review the time schedule for all operations;
- Observe the site survey benchmarks locations and review methods for maintaining vertical and horizontal control;
- Review documentation requirements;
- Review the survey documentation tables and plans which identify the locations where survey documentation information is required;
- Review repair procedures; and
- Discuss health and safety issues associated with cap installation.

The meeting will be documented by a person at the beginning of the meeting and minutes shall be transmitted to all parties.

2.3.2 Progress Meetings

Progress meetings will be held as needed (daily, weekly, etc.) at the work area. At a minimum, the meeting should be attended by the Construction Manager, Superintendent, and the Quality Assurance Engineer. The purpose of the meeting is as follows:

- Review the planned work activities and locations;
- Discuss the Installation Contractor's personnel and equipment assignments for the week;
- Review the previous week's activities and accomplishments;
- Review the work schedule;
- Discuss possible problems;
- Review any new test data; and
- Review data documentation requirements.

3.0 ORGANIZATION AND DOCUMENTATION REQUIREMENTS

3.1 ORGANIZATION OF CQA PROGRAM PARTIES

Overall responsibility for carrying out the provisions of this CQA Program is with the Construction Manager and Quality Assurance Engineer. The Quality Assurance Engineer is responsible for documenting, pursuant to this CQA Program, that construction at the CTWMA is consistent with the approved CTWMA design and this CQA plan. This documentation will also include the submittal of reports and other documents detailed throughout this CQA Program to ARCO on a timely basis, in addition to any other responsibilities described in this document.

The Laboratory is responsible for ensuring that all test data and reports completed by the Soils Testing Laboratory are submitted directly to the Quality Assurance Engineer. It is the responsibility of the Quality Assurance Engineer to resolve any disputes between the Laboratory and Installation Contractor.

The Installation Contractor (including any subcontractors that may be brought to the site) reports to ARCO's Construction Manager for matters relating to the CQA Program. The overall construction organization for this CQA plan is shown on Figure 2-1.

3.2 DAILY CONSTRUCTION REPORTS

The Quality Assurance Engineer will complete a daily summary report of each day's construction activities. Each construction report will contain, at a minimum, the following information:

- Date, project name, location and report preparer's name;
- The number and name of people on-site under the direction of the preparer for conducting CQA tasks;
- Time work starts and ends each construction work day. This information should also include any work stoppages due to inclement weather or insufficient equipment or personnel;
- Summaries of any meetings held and actions recommended or taken;
- Data on weather conditions including temperature, wind direction and speed, cloud cover, and any precipitation events;
- Installation Contractor's work force, type of equipment in use, weight of compactor, and materials delivered to or removed from the job site;
- Chronological description of work in progress including any notices to or requests from the Installation Contractor;
- Results (or a clear reference to where the results can be found) of testing performed on-site by personnel under the direction of the Quality Assurance Engineer or his representative;
- Problem/deficiency identification and corrective action section to document field problems and non-conforming materials or work as discussed in Subsection 3.2.1;
- Samples which were collected, marked, and sent to the Soils Testing Laboratory. These will be clearly indicated in the daily report by direct inclusion or by reference to the document containing such information. Likewise, reference should be included for any test data submitted by the Soils Testing Laboratory;
- An accurate record of observations that were made, and descriptions of the adequacy of the work that was performed;
- An accurate record of communications with other CQA Program parties, or any other outside companies, regulatory agencies, or consultants regarding the day's construction activities; and

- An accurate record of calibrations or standardizations performed on field testing equipment, including actions taken as a result of recalibrations. In addition, the results of other data recording will be kept in the daily log or will be adequately cross-referenced for each location.

To provide consistency, the Quality Assurance Engineer should use documentation forms. Example forms for daily construction reports, field moisture and density testing, material sampling logs, photograph logs, and nuclear density gauge calibration logs are included in Appendix A.

3.3 PROBLEM/DEFICIENCY IDENTIFICATION AND CORRECTIVE ACTION

Problem and/or deficiency identification and corrective actions will be documented in the Daily Construction Reports by the Quality Assurance Engineer when any construction material or activity is observed or tested that does not meet the requirements set forth in this plan. The documentation reports should be cross-referenced to the applicable forms, data sheets, checklists, and other reports that contain data or observations leading to the determination of a problem or deficiency. Problems/deficiency identification and corrective action documentation may include the following information:

- A description of the problem or deficiency, including reference to any supplemental data or observations responsible for determining the problem or deficiency;

- Location of the problem or deficiency;

- An opinion as to the probable cause of the problem or deficiency; and

- A recommended corrective action for resolving the problem or deficiency. If the corrective action has already been implemented, the observations and documentation to show that the problem or deficiency has been resolved should be included. If the problem or deficiency has not been resolved by the end of the day upon which it was discovered, then the report will clearly state that it is an unresolved problem or deficiency. If the problem or deficiency has not been resolved, the Quality Assurance Engineer and Construction Manager will discuss the necessary corrective actions to resolve the problem or deficiency as soon as possible.

The Construction Manager, working with the Quality Assurance Engineer, will determine if the problem or deficiency is an indication of a situation that might require changes to the plans and/or the CQA Program. If this situation develops, then a meeting will be held with the appropriate parties to determine if revisions to the plans or CQA Program should be made. Any revisions to the plans or the CQA Program must be approved by the Construction Manager, Quality Assurance Engineer, and, if appropriate, the regulatory agencies.

3.4 DRAWINGS OF RECORD

Drawings of record (also called "as-built" drawings") will be prepared by ARCO or its representatives to document the actual lines, grades, and conditions of the CTWMA upon completion. For soil components, the record drawings shall include survey data that show bottom and top elevations of a particular component and the plan dimensions of the component.

3.5 PHOTOGRAPHIC DOCUMENTATION

Photographs will be taken to document observations, problems, deficiencies, and work in progress. Photographs will be in color slide or print format and will be filed in chronological order in a protective file. A photograph log shall be maintained by the Quality Assurance Engineer. An example log form is included in Appendix A.

3.6 CONSTRUCTION DOCUMENTATION REPORTS

The Quality Assurance Engineer shall assemble one Construction Documentation Report for the entire construction project by combining the data and reports generated by the Quality Assurance Engineer. This report will be issued separately and as an appendix to the LAO Phase II final construction report.

At a minimum, the Construction Documentation Report will contain the following information:

- Documentation (as-built) set of drawings representing actual installation of each material as it relates to the plan views and individual details.

- Any written correspondence with the Montana Department of Environmental Quality;

- Summary of any problems and/or deficiencies encountered and their resolution during the construction, including any recurring problems or deficiencies that were discovered;

- Summary of any problems and/or deficiencies encountered and their resolution during construction, including any recurring problems or deficiencies that were discovered;

- Documentation that acceptance criteria were met, including comparison of procedure data with construction plans and specifications and requirements set forth in the CQA Program;

- Quality assurance test results; and

- Certification by the Quality Assurance Engineer that the construction meets the requirements of the approved plans and this CQA Program.

4.0 MATERIALS

The CTWMA Cap will consist of multiple layers of earthen materials over excavated mine wastes and associated soils from the LAO. These fill materials will consist of, from top to bottow:

- a 6-inch layer of growth media/seed bed layer;
- a 12-inch layer of cover soil;
- a 6-inch layer of granular material serving as a capillary break/drainage layer;
- an 18-inch layer of fine-grained materials serving as an infiltration barrier; and
- a 6-inch layer of mine wastes and associated soils from the LAO compacted to 95% of its Standard Proctor density serving as the prepared cap subgrade.

This cap is design to meet the requirements of the preferred alternative for the CTWMA identified in the *Butte Silver Bow Landfill/Clark Tailings Corrective Measures Assessment* (Pioneer, 1996b).

4.1 CTWMA SUBGRADE PREPARATION

The cap subgrade shall be properly prepared in order to provide adequate support for compaction and be free from mass movements. The subgrade will be composed of excavated materials (Type J Fill in the technical specifications) from Lower Area One (LAO). This material shall be free of debris and deleterious or objectionable materials. The material after compaction will have no extruding rocks or sticks that may effect the integrity of the overlying infiltration barrier layer.

4.2 INFILTRATION BARRIER LAYER

Generally fine-grained materials (Type K or L fill) will be removed from LAO or from a nearby borrow source and placed as the infiltration barrier layer above the prepared subgrade in the CTWMA cap. The materials shall be native silts, clayey silts, or clayey/silty sands. The material shall be approved by ARCO and shall meet the following gradation criteria, as defined in the Technical Specifications:

Particle Size	% Finer Than
3/8-inch	94
#4	90
#40	45
#200	25-70

Prior to acceptance of materials for use for the low permeability infiltration barrier, the Quality Assurance Engineer will visit the location where the material is being acquired to visually observe and field classify the material. Two sources of Type K or L (infiltration barrier) materials have been identified and tested by the Operator and the Design Engineer: the native

silts (ML) from the LAO and sandy clays (SC) from the Hollow pit north of the Clark Tailings. The native silts from LAO, if used for the infiltration barrier layer, shall be separated from other materials (such as tailings) to the extent feasible using standard excavating procedures and equipment during removal from LAO. While no mechanical separation or screening shall be required, materials should be excavated, loaded, and transported to the CTWMA.

Prequalification samples of both the ML materials from LAO and the SC materials from the Hollow pit were analyzed for natural moisture content, grain size distribution, Atterberg limits, moisture-density relationship, and hydraulic conductivity. The testing showed that these materials satisfy the technical specifications; in situ testing of these materials show that they consistently achieve hydraulic conductivities of less than 1.0E-06 cm/sec. A report on the prequalitification testing, including the test pad construction, is included in Appendix B.

Any alternative materials proposed for the low permeability soil used for the infiltration barrier shall have a classification of SC, CH, CL, or ML in accordance with ASTM D-2487, and an in-place compacted saturated hydraulic conductivity equal to or less than 1.0E-05 cm/sec within the density and moisture content range identified in the technical specifications. Alternative materials will be subjected to prequalification testing at the discretion of the Quality Assurance Engineer for the parameters listed in Table 1 prior to acceptance.

TABLE 1
PREQUALIFICATION TESTING REQUIREMENTS FOR ALTERNATIVE INFILTRATION BARRIER MATERIALS

PARAMETER	ASTM TEST METHOD
Water Content	D-2216 D-4643 D-4944 D-4954
Atterberg Limits	D-4318
Sieve Analysis	D-422 (gravel) D-1140 (fines)
Standard Proctor	D-698
Recompacted Hydraulic Conductivity	D-5084

The proposed materials may also be subjected to in situ hydraulic conductivity testing. This testing should be conducted in accordance with the two-stage borehole (Boutwell and Tsai, 1992) or sealed-double ring infiltrometer (ASTM D-5093) methods.

4.3 CAPILLARY BREAK

Imported granular material (Type M Fill) from rock pits near Centerville will be placed as the capillary break material over the infiltration barrier layer. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/4-inch	10-30
#200	0-10

Note: The 3-inch particle size is defined as material capable of passing a 3-inch screen.

4.4 COVER SOIL

Imported clean backfill (Type C Fill) will be placed on top of the capillary layer at a depth of 12 inches. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
6-inch average diameter	100
#200	5-20

Likely sources of Type C materials are the Hollow north of the site pit or ARCO-owned borrow sources west of LAO.

4.5 GROWTH MEDIA

Imported soil (Type G Growth Media) will be placed at a 6-inch depth over the cover soil in the CTWMA. The material shall be free from debris, rocks, roots, and deleterious or objectionable materials. This material shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	85-100
#4	50-90
#40	20-50
#200	10-40

Likely sources of Type G Growth Media materials are the Hollow north of the site pit or ARCO-owned borrow sources west of LAO.

4.6 GEOSYNTHETIC CLAY LINER

A geosynthetic clay liner (GCL) will be used to line the sedimentation basin south of the Clark Tailings, as shown on the drawings. The material shall be Bentomat ST, as manufactured by CETCO, or approved equivalent as described in the Technical Specifications.

Prior to installation, the Quality Assurance Engineer will review the Quality Assurance document provided by the manufacturer of the GCL. This document should describe the manufacturer's program and procedures for assuring the raw materials (particularly the sodium bentonite) used in the GCL meets the manufacturer's specifications and the final product meets the manufacturer's specifications. The manufacturer shall certify that the materials meet the manufacturer's standard specifications. The Quality Assurance Engineer will review the manufacturer's standard specifications and verify that they comply with the Technical Specifications. The Quality Assurance Engineer shall also verify that the manufacturer has certified that the GCL has been inspected for the presence of broken needles.

5.0 EARTHWORK

5.1 PLACEMENT OF LAO FILL MATERIALS

Materials excavated from LAO (Type H Fill and Type I Fill as defined in the Technical Specifications) and transported to the site will be placed to the lines and grades shown on the drawings in accordance with the specifications. The Quality Assurance Engineer will oversee the placement of the materials to monitor compliance with the specifications. This will include period measurements of moisture-density relationships and compacted densities and moisture contents.

The materials will be compacted from 85% to 95% of their maximum dry density (as determined via ASTM D-698), as defined in the specifications, at -2 to +2 percent of optimum moisture content. The Quality Assurance Engineer will have moisture-density relationship analyses conducted as material conditions warrant. The Quality Assurance Engineer will perform in-place tests to determine density and moisture of the compacted materials (via ASTM D-2922 and D-3017) to measure compliance with the specifications. The Quality Assurance Engineer shall perform moisture and density tests at a minimum frequency of three tests per acre per lift (or one test per each 500 cubic yards based on 12-inch lifts). If the Quality Assurance Engineer determines that the materials do not satisfy the regulations, he will define the area not in compliance (via additional testing) and that area will be repaired by the Installation Contractor. The Quality Assurance Engineer will retest repaired areas before approval.

5.2 SUBGRADE PREPARATION

The Installation Contractor will be responsible for preparing the subgrade for construction of overlying components according to the subgrade compaction specifications. Requirements for the preparation, placement, and compaction of Type J Fill include:

- Maintain positive surface drainage to avoid ponding of water on fill.
- The surfaces upon or against which Type J Fill will be placed, including previously placed and compacted layers, shall be clean of all objectionable materials, shall be moist but free of standing or ponded water; and shall be scarified as necessary, to provide a suitable bond between the existing and newly placed material.
- The uppermost 6 inches (compacted) of Type J Fill shall be placed in one lift over the portion of the CTWMA impacted by the placement of LAO materials to the line and grade as shown on the Drawings or as directed by ARCO.
- The moisture content shall be between plus 2 percent and minus 2 percent of the optimum moisture content as determined by ASTM D698. The moisture content shall be uniform throughout the lift.
- Materials containing less than 5 percent by dry weight of particles passing a #200 screen shall be compacted to a minimum of 90 percent of the maximum index density as determined by ASTM D4253.
- Materials containing greater than 12 percent by dry weight of particles passing a #200 screen shall be compacted to a minimum of 95 percent of the maximum index density as determined by ASTM D698.
- Materials containing 5 to 12 percent by dry weight of particles passing a #200 screen shall be compacted in accordance with the requirements of 5 or 6 above at the discretion of ARCO.
- In-place density tests on the subgrade material (Type J Fill) will be performed by the Quality Assurance Engineer or his representative with a nuclear density gauge in accordance with ASTM D-2922. Care will be taken to ensure the appropriate Proctor curve is used for comparing the results.

5.3 INFILTRATION BARRIER LAYER

5.3.1 Test Pads

Test pads were constructed in accordance with EPA guidance contained in *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA, 1993). A report on test pad construction and testing results is included in Appendix B.

5.3.2 Material Properties

The low permeability infiltration barrier materials shall meet the requirements as outlined in Section 4.2. During construction of the low permeability infiltration barrier layer, the Quality Assurance Engineer will obtain samples of on-site infiltration barrier material just before compaction. Sample material will be obtained on a more frequent basis when, in the judgement of the Quality Assurance Engineer, the low permeability infiltration barrier material has changed.

Samples will be periodically taken to confirm the properties of the infiltration barrier material. Table 2 summarizes minimum tests and testing frequencies of the infiltration barrier materials during the construction phase. Samples may be collected from the borrow source during material production; from stockpiles at the borrow source or the site; or from loose lifts placed as infiltration barrier materials. If statistical analysis of testing results shows the material being used for the infiltration barrier layer is relatively homogenous (i.e. there is little deviation from sample to sample), the frequency of testing may be reduced. The Quality Assurance Engineer, the Construction Manager, and the Project Manager shall meet to determine if the frequency of testing may be reduced.

Occasional deviations from construction specifications are acceptable as described in Table 3. Table 3 presents the maximum allowable frequency of deviations from the specifications during the placement and construction of the low permeability infiltration barrier layer.

5.3.3 Construction

The soil materials comprising the infiltration barrier of the soil cap may need to be processed prior to use. The principal preprocessing steps that must be required include the following:

- Drying of soil that is too wet.
- Wetting of soil that is too dry.
- Removal of oversized particles.
- Pulverization of clods of soil.
- Homogenization of nonuniform soil.

Tests are performed to confirm proper preprocessing, but visual observations by the Quality Assurance Engineer are also needed to confirm that proper procedures have been followed and that the infiltration barrier material has been properly processed.

TABLE 2
MATERIALS TESTS FOR INFILTRATION BARRIER MATERIALS

PARAMETER	TEST METHOD	MINIMUM TESTING FREQUENCY
Percent Fines (Note 1)	ASTM D1140	1 per 1,050 cu. yd. (Note 2)
Percent Gravel (Note 3)	ASTM D422	1 per 1,050 cu. yd. (Note 2)
Atterberg Limits	ASTM D4318	1 per 1,050 cu. yd. (Note 2)
Standard Proctor	ASTM D698	1 per 5,300
Construction Oversight	Observation	Continuous

Notes:
1. Percent fines is defined as percent passing the # 200 sieve
2. In addition, at least one test should be performed each day that soil is placed, and additional tests should be performed on any suspect material observed by CQA personnel.
3. Percent gravel is defined as percent retained on the # 4 sieve.

TABLE 3
MAXIMUM ALLOWABLE VARIATIONS

PARAMETER	MAXIMUM ALLOWABLE PERCENTAGE OF OUTLIERS
Atterberg Limits	5% of samples may fall outside specification and outliers not concentrated in one lift or one area
Grain Size	5% of samples may fall outside specification and outliers not concentrated in one lift or one area

All surfaces upon which infiltration barrier materials will be placed shall be free of all objectionable materials, as visually determined by ARCO, in accordance with the technical specifications (Section 02110- Site Clearing). Surfaces shall be free of standing water and shall be scarified as necessary so as to provide a suitable bond between the underlying materials and the infiltration barrier materials, particularly on side slopes.

The low permeability infiltration barrier materials shall not be frozen when placed, and shall not be placed on ice or frozen material. This material shall be placed in loose thickness lifts not to exceed 9 inches loose thickness or 6 inches compacted thickness according to the same procedures as developed during the test pad program and, at a minimum, the following requirements:

- All lifts shall be compacted to the minimum density in the technical specifications to achieve a maximum hydraulic conductivity of 1.0E-05 cm/sec.

- The moisture content, as determined by ASTM D2216, shall be between 0 to + 4% of the optimum moisture content as determined by ASTM D698 and shall be uniform throughout the lift. Placed materials not meeting this requirement, as determined by testing by the Quality Assurance Engineer, shall be scarified to the depth of the lift in question, wetted or dried as necessary to meet this requirement, and mixed to a uniform water content throughout the entire depth.

- Hand manipulated compaction equipment (vibrating drums or mechanical tampers) shall be used for working in confined areas and adjacent to structures.

- The daily work area should extend to such a distance necessary to minimize desiccation and crusting of the lift surface. The finished surface may be smooth rolled at the end of the day to promote precipitation runoff as necessary.

If desiccation, crusting, or sealing by rolling of the lift surface occurs prior to placement of the next lift, the area shall be scarified to a minimum depth of one inch or until sufficiently moist materials are encountered, whichever is greater. After scarification, the surficial infiltration barrier materials should be removed to obtain a moisture content at least two percent above optimum moisture content. Alternatively, the drier surficial materials may be stripped and mixed with moist materials to achieve a uniform moisture content satisfying the project requirements. Also, the addition of water to surfaces prior to placement of additional infiltration barrier materials may be utilized when necessary to maintain uniformly moist soil conditions.

The finished grade shall be within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed by ARCO, and a positive surface drainage shall be maintained to minimize ponding of water on the fill.

5.3.4 Compaction Control

Testing is required to control the moisture content and density of the low permeability infiltration barrier materials. The Quality Assurance Engineer will:

- Conduct in-place density and moisture content tests (via ASTM D-2922 and ASTM D-3017, respectively) at a minimum frequency of five tests per acre lift of soil (or one test per 160 cy of soil, based on 6-inch lifts);

- Conduct a direct oven moisture content test (ASTM D-2216) or a nuclear moisture test with a different gauge for every ten (10) nuclear moisture content tests (ASTM D-3017);

- Conduct a sand cone test (ASTM D-1556) or another nuclear density test with a different gauge for every twenty (20) nuclear density tests (ASTM D-2922); and

- Ensure that all test penetrations in the low permeability infiltration barrier are filled with bentonite pellets (by the QA Monitor conducting the tests) prior to placement of the next lift.

5.3.4.1 Sampling patterns

Sample locations during testing may be selected via two methods:

- The first method in selecting sampling points is by using the grid system established by Quality Assurance Engineer. The grid system will define a grid for locating samples, and the QualityAssurance Engineer will ensure that the grid patterns are staggered over successive lifts in accordance with EPA guidelines.

- The second method in selecting sampling points is by using the random selection method established by Quality Assurance Engineer (based on a random number generated that corresponds to a location on the lift) with no sampling points located within 2 meters of another sampling point in accordance with EPA guidelines.

5.3.4.2 Allowable variations and outliers

Failing results for field water content or density tests may be a result of several factors including:

- Human error in measurement of water content or dry unit weight;
- Natural variability of the soil or the compaction process leading to an anomaly at an isolated location;
- Limitations in the sensitivity and repeatability of the test methods; or
- Inadequate construction procedures that reflect broader-scale deficiencies.

If it is suspected that a test result is in error, the CQA personnel should return to the point where the questionable measurement was obtained. Several additional tests should be performed in close proximity to the questionable test. If three of the repeat tests provide satisfactory results, the questionable test result may be disregarded as an error.

A few randomly located test failures are acceptable, as the quality and integrity of the infiltration barrier layer will not be compromised. Table 4 specifies the maximum percentage of failing compaction tests allowable under the CQA plan.

TABLE 4
MAXIMUM PERCENTAGE OF FAILING COMPACTION TESTS

PARAMETER	MAXIMUM ALLOWABLE PERCENTAGE OF OUTLIERS
Water Content	3% and Outliers Not Concentrated in One Lift or One Area, and No Water Content Test Value Less than 2% or More than 3% of the Allowable Value
Dry Density	3% and Outliers Not Concentrated in One Lift or One Area, and No Dry Density Test Value Less than 0.8 kN/m^3 (5pcf) Below the Required Value

5.3.4.3 Corrective actions

If it is determined that an area does not conform with specifications and needs to be repaired, the extent of the area requiring repair will be defined by the Quality Assurance Engineer through additional testing around the failed area. Additional tests will be performed until the failing area is bracketed by tests passing the specifications. In this way, the failing area can be properly defined and repaired. The Installation Contractor will repair the failing area defined by the Quality Assurance Engineer.

5.3.5 Protection of Work

During construction, the low permeability infiltration barrier should be protected from detrimental climatic effects by incorporating the following procedure:

- No frozen low permeability infiltration barrier material shall be placed.

- Low permeability infiltration barrier material shall not be placed on a previous lift of low permeability material which is frozen. Frozen in-place low permeability infiltration barrier material shall be removed prior to placement of additional low permeability infiltration barrier material.

- Low permeability infiltration barrier material which has been subjected to a freeze/thaw cycle(s) shall be scarified and/or disked prior to recompaction and prior to placement of subsequent lifts of low permeability infiltration barrier material.

- Exposed finished lifts of infiltration barrier material should be sprinkled with water daily to minimize desiccation, as necessary.

- At the end of each day's construction activities, completed lifts or sections of compacted low permeability infiltration barrier material may be sealed by rolling with a rubber tire or

water, as needed.

- Proper grading should be provided at the end of each workday to assure adequate runoff in the event of overnight rain.

5.4 CAPILLARY BREAK

Capillary break materials (Type M Fill) shall be transported and placed in one lift of 6 inches so as to minimize the migration of fine-sized particles into void spaces. This material shall not be pushed more than 100 feet nor end dumped higher than 10 feet to maintain proper size distribution. The finished grade shall be compacted sufficiently to support traffic by construction equipment, within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed by ARCO. Gradation data for this material will be provided by the supplier. Testing frequency for the gradation, via ASTM D-422 will consist of 1 test per 10,000 cubic yards to monitor compliance with the specifications. Additional tests may be conducted at the discretion of the Quality Assurance Engineer.

5.5 COVER SOIL

Cover soil (Type C Fill) shall be placed as loosely as possible to promote vegetative growth in lifts not to exceed 12 inches. The material shall not be frozen when placed and not be placed on ice or frozen material. Finish grading the cover soil to within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed by ARCO. Maintain positive surface drainage to minimize ponding of water on the fill. Testing frequency for the gradation, via ASTM D-422 will consist of 1 test per 10,000 cubic yards to monitor compliance with the specifications. Additional tests may be conducted at the discretion of the Quality Assurance Engineer.

5.6 GROWTH MEDIA

Growth media (Type G media) shall be placed as loosely as possible in lifts not to exceed 6 inches to promote vegetative growth. Best management practices (BMPs) shall be employed to minimize erosion until vegetation is established. The material shall not be frozen when placed and not be placed on ice or frozen material. Finish grading the growth media to within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed by ARCO. Maintain positive surface drainage to minimize ponding of water on the fill. Testing frequency for the gradation, via ASTM D-422 will consist of 1 test per 10,000 cubic yards to monitor compliance with the specifications. Additional tests may be conducted at the discretion of the Quality Assurance Engineer.

5.7 GEOSYNTHETIC CLAY LINER

Upon delivery of the GCL to the site, the Quality Assurance Engineer will document the manufacturer, the lot numbers, and the roll numbers of the materials delivered to the site. The materials shall be stored covered and off the ground in accordance with the manufacturer's recommendations and the Technical Specifications. The Quality Assurance Engineer will review the Installatin Contractor's submittals and determine if the materials satisfy the technical specifications.

Prior to installation, at the discretion of the Quality Assurance Engineer, conformance samples of the GCL may be collected and submitted to an independent laboratory for analysis. These samples should be collected in conformance with ASTM D-4354, Sampling of Geosynthetics for Testing. The samples may be analyzed for mass per unit area (ASTM D-5261) and the free swell of clay component (GRI-GCL1). The samples may also be analyzed for other performance-oriented parameters (these are typically performed at less frequent intervals) including hydraulic conductivity (ASTM D-5084); direct shear (ASTM D-5321); and peel testing (ASTM D-413). The Quality Assurance Engineer will determine if the test results comply with the specification via ASTM D-4759.

Prior to installation, the Quality Assurance Engineer will approve the prepared subgrade. The subgrade shall be free of vegetation, debris, sticks, sharp rocks, void spaces, ice, abrupt elevation changes, standing water, cracks larger than 0.25-inch, and any other materials or conditions that may damage the GCL. The subgrade shall have no protrusions extending more than 0.5-inch from the surface.

The Quality Assurance Engineer will monitor the installation of the GCL to check conformance with the manufacturer's guidelines for installation and the technical specifications. The Quality Assurance Engineer will monitor the following.

- Equipment used to deploy the GCL does not compromise the integrity of the subgrade.
- The minimum overlap on the seams shall be six inches.
- A minimum of 0.25 pounds of granular bentonite shall be applied to all seams.
- All seams on slopes greater than 4H:1V are oriented parallel to the slope.
- All materials are anchored in an anchor trench in accordance with the drawings and specifications.
- All tears, holes, and rips in the GCL (or its component geotextiles) are repaired in accordance with the manufacturer's recommendations and the technical specifications. If the damage involves the clay portion of the GCL, the repair shall consist of overlapping the damaged area with a full GCL patch.
- All patches used for repairs shall extend at least 12 inches beyond the damaged area in all directions.
- GCL patches will be seamed with granular bentonite applied a minimum rate of 0.25 pounds per lineal foot.

After deployment and seaming of the GCL, cover soil will be placed as shown on the drawings. Before covering the GCL, it must be approved by the Quality Assurance Engineer. During any working day, only as much GCL should be deployed as can be seamed and covered in that day, particularly if there is a threat of inclement weather. GCL should not be deployed during precipitation events that may lead to premature hydration of the clays. During placement of cover soil, the Quality Assurance Engineer will monitor type and depth of cover soil placed over the GCL. Cover soil will be placed according the following guidelines (in accordance with the specifications and the manufacturer's regulations).

- Soil placement will not damage the GCL or underlying materials.
- A minimum of 12-inches of soil shall be maintained between the GCL and the tires or tracks of equipment used to spread and place the soil. For any high-traffic areas, a minimum of 24-inches of soils shall be maintained between the GCL and the tires or tracks.
- Soil shall be placed in such a way as to prevent soil partilces from entering the GCL overlap zones (seams). Where possible, the backfilling will proceed in the direction of downgradient shingling.
- Soil shall be placed so that no excess tensile stress is mobilized in the GCL. This will require backfilling on side slopes to proceed from the bottom of the slope upward.

6.0 REFERENCES

American Society for Testing and Materials (ASTM), 1916 Race St., Philadelphia, PA, Standard Test Methods:

ASTM D-413, "Rubber Property-Adhesion to Flexible Substrate"
ASTM D-422, "Particle Size Analysis"
ASTM D-698, "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 5.5-lb (2.48 kg) Rammer and 12-in (305 mm) drop"
ASTM D-854, "Specific Gravity of Soils"
ASTM D-1140, "Amount of Material Finer than the No. 200 Sieve"
ASTM D-2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock"
ASTM D-2922, "Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)"
ASTM D-3107, "Water Content of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)"
ASTM D-4318, "Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
ASTM D-4759, "Determining the Specification Conformance of Geosynthetics"
ASTM D-5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter"
ASTM D-5093, "Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed Inner Ring"
ASTM D-5261, "Measuring Mass per Unit Area of Geotextiles"

Boutwell, G.P., and Tsai, C.N., 1992, "The Two-Stage Field Permeability Test for Clay Liners," *Geotechnical News*, Vol. 10, No.2, pp. 32-34.

EPA, 1993, *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93/182, U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C., September.

GRI-GCL1, "Free Swell Conformance Test of Clay Component of a GCL," Geosynthetics Research Institute, Drexel University, Philadelphia, Pennsylvania.

Pioneer Technical Services, 1996a, *Lower Area One (LAO)/Clark Tailings Disposal Area Phase I, Segment II LAO Expedited Response Action Technical Specifications*, Prepared for Atlantic Richfield Company, Anaconda, Montana, August.

Pioneer Technical Services, 1996b, *Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment, Second Draft*, prepared for Butte-Silver Bow Department of Public Works, Butte, Montana, December.

APPENDIX A

EXAMPLE FORMS

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT

Page ___ of ___

DATE/TIME: ______________________

PROJECT ______________________

JOB NO. ______________________

CLIENT ______________________

CONTRACTOR ______________________

PROJECT MANAGER ______________________

DAY: S ___ M ___ T ___ W ___ TH ___ F ___ S ___

WEATHER: Brite Sun ___ Clear ___ Overcast ___ Rain ___ Snow ___

TEMP.: To 32 ___ 32-50 ___ 50-70 ___ 70-85 ___ 85 up ___

WIND: Still ___ Moder. ___ High ___

HUMIDITY: Dry ___ Moder. ___ Humid ___

FIELD ACTIVITIES:

BY ______________________ TITLE ______________________

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT (cont'd.)

Page ___ of ___

DATE/TIME: ____________________

PROJECT________________________________

JOB NO. ________________________________

FIELD ACTIVITIES (cont'd.):

BY______________________________ TITLE______________________

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

FIELD DENSITY TEST SUMMARY

Project
Project No.
Tests on
Page ___ of ___

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services
PO Box 3445
Butte, MT 59702
(406) 782-5177

NUCLEAR DENSITY GAUGE STANDARD COUNT LOG

GAUGE ____________________

DATE	OPERATOR	LOCATION	DENSITY COUNT	MOISTURE COUNT

PO Box 3445
Butte, MT 59702
(406) 782-5177

FIELD SOIL SAMPLING LOG FORM

Project Name____ Project # ____________

PIONEER ID#	CLIENT ID#	DATE	SAMPLED BY	SAMPLE TYPE	LOCATION	ANALYSES

PHOTO LOG

ROLL NO.	PHOTO NO.	DESCRIPTION

APPENDIX B

TEST PAD CONSTRUCTION AND RESULTS

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

MEMORANDUM

DATE: August 7, 1996

TO: Eric Jacobsen, ARCO

FROM: Brad Archibald, P.E. BA

RE: LAO Test Pads Construction and In Situ Permeability Testing Report

Test pads of the possible infiltration barrier materials for the Clark Tailings were constructed at Lower Area One (LAO) in Butte on July 1 to July 3 and July 9. This memo summarizes the construction activities and testing results. Daily reports are included in Appendix A.

Initially three test pads were planned: one consisting of 50% LAO clay/silt and 50% silty/clayey sand from Hollow's pit; one consisting of 75% LAO clay/silt and 25% of decomposed granite from Hollow's pit; and one consisting of 100% silty/clayey sand from Hollow's pit. Ultimately, four pads were constructed, as follows:

CTTP1:	50% LAO clay/silt mixed with 50% Hollow silty/clayey sand
CTTP2:	50% LAO clay/silt mixed with 50% decomposed granite from Hollow's pit
CTTP4:	100% Hollow silty/clayey sand
CTTP5:	100% LAO clay/silt

Test Pad CTTP3 was not constructed because of difficulties compacting overly wet tailings as a base.

Weather during test pad construction was generally dry and very warm. Highs generally reached the 80s to low-90s; there was just a trace of precipitation on the afternoon of July 3.

SAMPLING METHODOLOGY

Prior to construction of the test pads, permeability testing of selected materials that were being considered as possible infiltration barrier layers at that time was completed (via ASTM D5084, Method C). The materials tested included the native clayey sands from Hollow's pit; a mixture of

100% post-consumer paper & 100% vegetable based inks

LAO tailings and the native clay/silt from below the LAO tailings; and the native clay/silt from LAO by itself. These data, included in Appendix G, indicated that the materials being considered could meet the regulatory vertical permeability requirement of 1.0E-05 cm/sec.

After the laboratory permeability testing was completed, the list of potential infiltration barrier layer materials was refined slightly. No additional laboratory permeability testing was conducted, however. It was felt that the data from the original testing was indicative of the ability of the proposed materials to meet the permeability requirements.

Prior to construction of the test pads, samples of the subgrade, tailings, and the proposed infiltration barrier materials (including mixtures) were prepared and analyzed for moisture density relationship via ASTM D698 (standard Proctor). These "preconstruction" samples were used to determine if the materials being used to construct the test pads were being installed in accordance with the target specifications. During construction, composite samples of the tailings and the infiltration barrier materials were collected from selected lifts. Sampling frequency was complied with the EPA guidance for constructing test pads contained in *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA/600/R-93/182). These "post-construction" samples were analyzed for standard Proctor density (ASTM D698). Some of these samples were also analyzed for particle size distribution (through the No. 200 sieve, via ASTM C136/C117); Atterberg limits (via ASTM D4318); and moisture content (via ASTM D2216).

During construction of the test pads, the in place density and moisture content of the infiltration barrier materials was measured (via ASTM D2922 and ASTM D3017, respectively) at a typical rate of four tests per lift, which meets the minimum sampling frequency of one test per 400 ft^2 cited in EPA's guidance. To verify the results of the field testing, four samples were collected from a lift of CTTP4 infiltration barrier materials from the locations of field tests. These samples were submitted to the laboratory for moisture content analysis via ASTM D2216. The results, included in Appendix D, showed that the field measurements were very close to the laboratory results, with the nuclear gauge reading an average of 0.4% less moisture content than the laboratory method. Also, sand cone density and moisture results from tests conducted by NTL Engineering and Geoscience (included in Appendix F) during installation of the Boutwell permeameters correlated, in general, very well with the field measurements. The results from the two techniques cannot be correlated directly because the sampling locations were not precisely the same.

SUBGRADE PREPARATION

Prior to construction, an approximately 30'x50' area was leveled for each test pad and the subgrade, a poorly graded sand, was compacted to a minimum of 90% of it's standard Proctor density. This was completed on July 1. Field density test results (1 through 22 from July 1) are included in Appendix B. (Note that on July 1 two nuclear density gauges were used because of concerns about Pioneer's gauge. Based on ensuing standard counts and laboratory verification of moisture readings, only Pioneer's gauge was used after July 1.) The Proctor curve for the subgrade materials is included as Plate P-1 in Appendix C.

TAILINGS PLACEMENT

A 12-inch lift of tailings excavated from LAO was placed directly over the compacted subgrade for each test pad. The purpose of placing the tailings was to assess the effectiveness of the dewatering technique and to mimic as closely as possible the actual capping conditions. Therefore, the intent was to compact the tailings lift to 95% of the maximum dry density at ±2% of the optimum moisture content. Based on the fine fraction observed in the tailings, it was determined in the field on July 2 that they were best represented by preconstruction Proctor curve Plate P-3 (Appendix C). (Additional samples were collected during placement and analyzed by ASTM D698 for standard Proctor density, as described below.)

The tailings under CTTP1 were placed and compacted in one lift on July 2. The lift was compacted with a Caterpillar D6H Low Ground Pressure (LGP) dozer. The lift was approved based on nuclear density tests T22 - T25 on July 2 and Plate P-3. However, it should be noted that a Proctor from a composite sample collected during placement of the tailings lift (Plate P-12, Appendix C) showed that the materials were actually wet of optimum (by 3.4 to 10%, with an average moisture content of 6.5% above optimum) and not in compliance with the ±2% of optimum moisture content specification. Also, based on Plate P-12, the tailings were compacted to an average of 89.1% of the maximum dry density, below the target of 95%. Compaction testing data are summarized on Table 1.

The tailings under CTTP2 were placed in two lifts (one 8-inch compacted lift and one 4-inch compacted lift) on July 2. The tailings were generally wet of optimum moisture (T9, T10, and T12 - T16 from July 2, Appendix B), in some cases beyond the allowable ± 2% identified in the specifications. Field compaction testing data are summarized on Table 2. In the interest of completing the test pads, the tailings lift for test pad 2 was approved. Based on the Proctor curve for a composite sample taken from the tailings during placement (Plate P-11, Appendix C), which showed the tailings were an average of 7.6% above optimum moisture and the average compaction was 88.9% of the maximum dry density.

The tailings under CTTP4 were placed and compacted in one lift on July 2. The lift was compacted with a Caterpillar D6H LGP dozer. The lift was approved based on nuclear density test results T26 - T30 on July 2 (Appendix B). However, the lift was outside the specification of ±2 of optimum moisture content, based on comparison to Plate P-3 (the preconstruction Proctor) and P-10 (from a composite sample taken during placement of the lift). Based on Plate P-10, the average density of the tailings was 89.3% of the maximum dry density, and the average moisture content was 7.6% above optimum. Compaction testing data are summarized on Table 3.

The tailings under CTTP5 were placed on July 2 in one 10- to 12-inch lift, which was compacted with the CAT D6H LGP dozer. The lift was approved on July 3, after drying overnight, based on nuclear density tests T8 - T11 on July 3 (Appendix B). Compaction testing data are summarized on Table 4. No sample was collected during placement of the tailings lift for CTTP5; therefore, the field data are only compared to the preconstruction Proctor (Plate P-3).

Overall, the tailings materials did not meet the target compaction of 95% of the maximum dry density based on the Proctor samples collected during construction of the test pads. The variation between the pre-construction Proctor values and the values for samples collected during construction is due to the heterogeneity of the LAO tailings. Achieving the 95% compaction specification at full-scale will be possible, however. During the test pad construction, the materials were placed well wet of optimum moisture and were compacted with a D6H LGP bulldozer. Utilizing better compaction equipment and/or techniques will result in better compaction of the tailings. For example, during construction of the sedimentation ponds at LAO, berms were constructed of excavated LAO tailings materials. Compaction to 95% of the standard Proctor density was consistently achieved during construction of these berms.

The fact that most of the tailings upon placement were too wet to meet the ±2% of optimum moisture content specification is not necessarily indicative of full-scale activities. Full-scale dewatering may be more effective than the dewatering conducted in the test pits. Also, the tailings used as part of the test pad construction had a large fines fraction; therefore some of the sandier tailings materials present within the LAO excavation area may dewater more easily than these materials did. Nonetheless, it may be necessary to dry the tailings before compacting within the Clark Tailings Combined Waste Management Area to meet the ±2% of optimum moisture content specification.

CTTP1 INFILTRATION BARRIER LAYER

Pad CTTP1 consists of 50% LAO clays mixed with 50% silty sands from Hollow's borrow pit. The materials were mixed with a bucket loader. An attempt was made to mix the materials by wind-rowing and using a grader to mix, but this was not as successful as mixing with the loader. The materials were placed in three approximately 9-inch loose lifts, for a total compacted pad thickness of 1.5 feet ± 0.1 foot. (Vertical control and measurements were provided by Bob Lash of Jordan Contracting, Inc. and verified by Brad Archibald and/or Pat Sampson of Pioneer.) The first lift was applied on July 2 and compacted with the D6H LGP dozer. The material was far over the optimum moisture content (per nuclear density tests T34 - T38 on July 2 and Plate P-6, the preconstruction Proctor). The material was allowed to dry overnight. After compacting the material with the D6H LGP on the morning of July 3 (to repair any desiccation cracking that may have occurred overnight), the lift was tested and approved based on nuclear density tests T2 - T5 on July 3. The material was between 0.5 to 2% above optimum moisture content based on Plate P-6. However, based on Plate P-13, from a sample collected during placement of the lift, the optimum moisture was 3 to 4.5% above optimum moisture. The target for the materials was from 0 to +4% above optimum moisture content. The average compaction of the lift, based on Plate P-13, was 96.2% of the maximum dry density. Compaction testing data are summarized on Table 5. Also, a composite sample collected during placement of this lift was analyzed for particle size distribution and Atterberg limits. These data (included in Appendix E) show that the mixture was a silty sand (SM) with 38.9% fines and a plasticity index of 4.2.

Lift 2 of CTTP1 was placed on July 3. The materials for lift 2 had been mixed on July 2 and were spread and allowed to dry overnight. The 9-inch loose lift was placed and compacted with the D6H LGP dozer. The lift was approved based on nuclear density tests T12 - T15 from July 3. The materials were from 1.9 to 4.2% above optimum moisture, based on Plate P-6. The Proctor curve for a composite sample collected during placement of the lift, Plate P-15, shows that the materials were an average of 2.3% above optimum moisture content. The average density was 95.8% of the maximum dry density. Field compaction testing data are summarized on Table 5. A composite sample of this lift was classified as a clayey sand (SC) with 43.1% fines and a plasticity index of 12.2. The moisture content of the composite sample was 22.1%, comparable to that measured in the field with the nuclear density gauge. Laboratory data are included in Appendix E.

Lift 3 of CTTP1 was also placed on July 3, with the materials and methods used for Lift 2. Four passes of the D6H LGP were used for compaction of the lift. The lift was approved based on nuclear density tests T34 - T37 on July 3. The materials were from 0.5 to 1.5% above optimum moisture content, based on Plate P-6 (data are summarized on Table 5). No sample was collected for laboratory testing during the construction of this lift.

The completed pad was covered with a protective layer of visquene. In situ permeability testing of the test pad was conducted from July 8 through July 14 by NTL Engineering and Geoscience with the assistance of Pioneer personnel. The testing consisted of vertical permeability testing in accordance with the Boutwell procedure cited in EPA's *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA/600/R-93/182). NTL's report on the in situ permeability testing is included as Appendix F. Five Boutwell permeameters were installed on CTTP1. Of the five, two (1-1 and 1-5) drained rapidly. Based on concerns regarding the seals on these two permeameters, they were removed and reinstalled. However, they continued to drain rapidly. The vertical permeability (k_v) in the three remaining permeameters ranged from 7.2E-07 to 2.7E-07 cm/sec. These data indicate that the materials used to construct CTTP1 can satisfy the permeability requirement of 1.0E-05 cm/sec, but that the compaction technique used allowed voids to remain (as evidenced by the two rapidly draining permeameters). Note that sand cone density results conducted by NTL were comparable to the nuclear density gauge testing results reported by Pioneer; however, since the sample locations were not precisely the same, the results cannot be compared directly.

CTTP2 INFILTRATION BARRIER LAYER

CTTP2 was originally to consist of 75% LAO clays and 25% decomposed granite. However, after mixing this material and allowing to dry overnight (July 2 to July 3), the material was still far too wet to work, and this mixture of materials was abandoned. The LAO clays were spread and allowed to dry from July 3 to July 9. On July 9, CTTP2 was constructed of a mixture of 50% LAO clays and 50% decomposed granite from Hollow's pit. These materials were mixed in the same manner as the CTTP1 materials.

CTTP2 was placed in three 9-inch loose lifts. The total thickness of the completed, compacted pad is 1.5 feet ± 0.1 feet. Each lift was placed with the D6H LGP dozer and compacted with four passes of the same dozer.

The first lift was approved based on nuclear density tests T13 - T16 on July 9. The materials were all above 90% of the standard Proctor density, based on Plate P-18 (the preconstruction Proctor). The materials varied from -2.3 to +1.9% of optimum moisture content, also based on Plate P-18. When compared to a Proctor curve from a composite sample collected during placement of the lift (Plate P-21), the materials were compacted to an average of 97% of the maximum dry density at an average moisture content of 1.6% less than optimum, which was outside the target range of 0 to +4% of optimum moisture. Compaction testing data are summarized on Table 6. A composite sample from this lift was analyzed for particle size distribution and Atterberg limits; data are included in Appendix E. The mixture was classified as a silty sand (SM) with 31.9% fines; the plasticity index was 3.0.

The second lift was approved based on nuclear density tests T17 - T22 on July 9. In this lift, moisture varied from -1.1 to +6% of optimum moisture content, based on the preconstruction Proctor (Plate P-18). The average density was 92.9% of the maximum dry density (based on the preconstruction Proctor). Retests near two samples well out of the target of 0 to +4% above optimum moisture content (T17 and T19) showed the materials to be much closer to the target range. No sample from this lift was submitted for laboratory compaction analysis. Testing data are summarized in Table 6.

The third lift was approved based on nuclear density tests T23 - T26. In this lift, moisture contents ranged from -1.3 to +2.3% of optimum moisture, with an average of 0.2% above optimum (when compared to the preconstruction Proctor). The average density was 96.0% of the maximum dry density. No sample from this lift was submitted for laboratory compaction analysis. Testing data are summarized in Table 6.

The completed pad was covered with visquene. In situ vertical permeability testing was commenced on July 18. Five individual Boutwell permeameters were installed on the pad. However, all but one of the permeameters drained rapidly. The permeameters were refilled a number of times, but would not hold water. The one permeameter that did not drain rapidly showed the k_v to be 2.6E-07 cm/sec, which indicates that the material is capable of satisfying the 1.0E-05 cm/sec requirement. However, the rapidly draining permeameters indicate that the compaction technique used on this pad did not provide a uniform infiltration barrier layer. NTL's report on the in situ permeability testing is included in Appendix F.

It should be noted that these materials required water addition during placement to get near the objective of 0 to +4% of optimum moisture content, but this was only after the materials had been spread and dried from July 3 to July 9.

CTTP4 INFILTRATION BARRIER LAYER

CTTP4 was constructed from 100% silty/clayey sand from the Hollow borrow source. The materials were excavated and stockpiled on site on July 2 and 3. The infiltration barrier layer was placed in three 9-inch loose lifts, and the total compacted pad thickness was 1.5 feet ± 0.1 foot. These materials were compacted with an Ingersoll-Rand SP-48 sheepsfoot roller without vibration.

The first lift was placed on July 2. The materials placed were well dry of optimum moisture content, as described in the daily log (Appendix A). After several rounds of ripping and adding water, the moisture was within the target range of 0 to 4% above optimum moisture content (based on the preconstruction Proctors, Plates P-8 and P-9). The first lift was approved in the early afternoon of July 3 based on nuclear density tests T39 - T42, after eight passes with the compactor. The average density was 94.1% of the maximum dry density when compared to the preconstruction Proctors. The moisture content ranged from 2 to 3% above optimum moisture when compared to the preconstruction Proctors, within the target range of 0 to +4% of the optimum moisture content. Field compaction testing data are summarized on Table 7.

The second lift was placed with the D6H LGP dozer with water being added before and during placement. The lift was compacted with four passes of the sheepsfoot roller. It was approved based on nuclear density tests T43 - T46 on July 3, even though two of the four tests were slightly below the target optimum moisture content. Based on the Proctor curve for a composite sample collected during placement of the lift (Plate P-17), the average density was 97.6% of the maximum dry density and the average moisture content was 1.5% below optimum. Field compaction testing data are summarized on Table 7. A composite sample of this lift was classified as a clayey sand (SC) with 33.3% fines. The plasticity index was 7.2 and the moisture content was 13.1%. Laboratory data are included in Appendix E.

The third lift was placed and compacted in the same manner as the second lift. However, more water was added during the placement of the third lift (as determined by qualitative observations). The materials were very near their plastic limit during placement. After compaction (with four passes of the roller), the lift was approved based on nuclear density tests T47 - T50 on July 3. These tests were all within the target moisture content range, based on the preconstruction Proctor. However, when compared to a Proctor curve for a composite sample collected during construction of this lift (P-16), the average moisture content was 0.1% above optimum, but two of the four tests were below the optimum moisture content. The average density was 98.6% of the maximum dry density. Field compaction testing data are summarized on Table 7. A composite sample of this lift was classified as a clayey sand to a silty sand (SC-SM) with 35.1% fines. The plasticity index was 6.9 and the moisture content was 13.2%. Laboratory data are included in Appendix E.

The completed pad was covered with a protective lift of decomposed granite and visquene. In situ permeability testing was conducted by NTL from July 8 to July 15. Five individual Boutwell permeameters were installed on the pad. Originally, one of the permeameters (4-4) drained rapidly. Because of uncertainties regarding the seal, this permeameter was reset. However, after a few days of conducting the in situ permeability testing, a leak in the permeameter was observed by Pioneer personnel conducting the daily monitoring. Therefore, the results from permeameter 4-4 should be disregarded. (It should be noted that k_v measured by this permeameter still met the 1.0E-05 cm/sec requirement even with the leak.) The average k_v in the remaining four permeameters was 2.2E-07 cm/sec. NTL's report on the vertical permeability testing is included in Appendix F.

CTTP 5 INFILTRATION BARRIER LAYER

CTTP5 was constructed of 100% LAO clay/silt. The pad was constructed in three 9-inch loose lifts, and the total thickness is 1.5 feet ± 0.1 foot. Each lift was placed with the D6H LGP dozer and compacted with four passes of the same dozer.

Note that the materials used to construct this pad were spread and allowed to dry from July 3 to July 9. It would not have been possible to construct a pad of these materials within a day after they were excavated from the LAO test pits because of excessive moisture content. However, this is not necessarily indicative of full scale conditions, since full scale dewatering may be more effective than that done to accommodate excavation of the clays for test pad construction.

Lift 1 was approved based on nuclear density tests T1 - T4 on July 9 and the preconstruction Proctor (Plate P-4). Note that some of the materials were wet of the 0 to +4% above optimum moisture content target, even after drying from July 3 to July 9. The density of the materials was 93.0% of the maximum dry density and the average moisture content was 5.2% above optimum. Field compaction testing data are summarized on Table 8.

Lift 2 was approved based on tests T5 - T8 on July 9 and the preconstruction Proctor (Plate P-4). When compared to a Proctor curve for the composite sample collected during placement of this lift (Plate P-20), the materials were at an average density of 96.7% of the maximum dry density and were an average of 1.3% above optimum moisture content. Field compaction testing data are summarized on Table 8. A composite sample of this lift was classified as a silt (ML) with 53% fines. The plasticity index was 3.4. Laboratory data are included in Appendix E.

Lift 3 was approved based on tests T9 - T12 on July 9 and the preconstruction Proctor (Plate P-4). The density of the materials was 97.8% of the maximum dry density and the average moisture content was 2.5% above optimum. Field compaction testing data are summarized on Table 8.

The completed test pad was covered with visquene and a protective layer of decomposed granite. In situ permeability testing was conducted by NTL, with the assistance of Pioneer personnel, from July 18 to July 23. Five individual Boutwell permeameters were installed on the pad. The k_v values ranged from 1.3E-07 cm/sec to 6.8E-07 cm/sec, with an average of 3.0E-07 cm/sec. NTL's report on the in situ permeability testing is included in Appendix F.

TABLE 1. CTTP1 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP1/T1	JUL2, T22	104.8	17.4	P-3	107.5	17.0	0.975	0.4
(PRECON)	JUL2, T23	104.1	18.9	P-3	107.5	17.0	0.968	1.9
	JUL2, T24	101.9	15.4	P-3	107.5	17.0	0.948	-1.6
	JUL2, T25	102.4	22.1	P-3	107.5	17.0	0.953	5.1
	MEAN	103.3	18.5				0.961	1.4
CTTP1/T1	JUL2, T22	104.8	17.4	P-12	116.0	12.0	0.903	5.4
(POSTCON)	JUL2, T23	104.1	18.9	P-12	116.0	12.0	0.897	6.9
	JUL2, T24	101.9	15.4	P-12	116.0	12.0	0.878	3.4
	JUL2, T25	102.4	22.1	P-12	116.0	12.0	0.883	10.1
	MEAN	103.3	18.5				0.891	6.5

TABLE 2. CTTP2 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP2/T1	JUL2, T9	105.8	18.3	P-3	107.5	17.0	0.984	1.3
	JUL2, T10	106.3	19.0	P-3	107.5	17.0	0.989	2.0
CTTP2/T2	JUL2, T12	101.0	23.8	P-3	107.5	17.0	0.940	6.8
(PRECON)	JUL2, T13	106.4	20.1	P-3	107.5	17.0	0.990	3.1
	JUL2, T14	106.4	18.6	P-3	107.5	17.0	0.990	1.6
	JUL2, T15	105.4	20.1	P-3	107.5	17.0	0.980	3.1
	JUL2, T16	99.8	24.6	P-3	107.5	17.0	0.928	7.6
	MEAN	104.4	20.6				0.972	3.6
CTTP2/T1	JUL2, T9	105.8	18.3	P-11	117.5	13.0	0.900	5.3
	JUL2, T10	106.3	19.0	P-11	117.5	13.0	0.905	6.0
CTTP2/T2	JUL2, T12	101.0	23.8	P-11	117.5	13.0	0.860	10.8
(POSTCON)	JUL2, T13	106.4	20.1	P-11	117.5	13.0	0.906	7.1
	JUL2, T14	106.4	18.6	P-11	117.5	13.0	0.906	5.6
	JUL2, T15	105.4	20.1	P-11	117.5	13.0	0.897	7.1
	JUL2, T16	99.8	24.6	P-11	117.5	13.0	0.849	11.6
	MEAN	104.4	20.6				0.889	7.6

TABLE 3. CTTP4 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP4/T1	JUL2, T26	103.7	20.3	P-3	107.5	17.0	0.965	3.3
(PRECON)	JUL2, T27	104.2	22.0	P-3	107.5	17.0	0.969	5.0
	JUL2, T28	105.0	18.4	P-3	107.5	17.0	0.977	1.4
	JUL2, T29	104.0	20.8	P-3	107.5	17.0	0.967	3.8
	JUL2, T30	101.0	23.8	P-3	107.5	17.0	0.940	6.8
	MEAN	103.6	21.1				0.964	4.1
CTTP4/T1	JUL2, T26	103.7	20.3	P-10	116.0	13.5	0.894	6.8
(POSTCON)	JUL2, T27	104.2	22.0	P-10	116.0	13.5	0.898	8.5
	JUL2, T28	105.0	18.4	P-10	116.0	13.5	0.905	4.9
	JUL2, T29	104.0	20.8	P-10	116.0	13.5	0.897	7.3
	JUL2, T30	101.0	23.8	P-10	116.0	13.5	0.871	10.3
	MEAN	103.6	21.1				0.893	7.6

TABLE 4. CTTP5 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP5/T1	JUL3, T8	110.6	15.1	P-3	107.5	17.0	1.029	-1.9
(PRECON)	JUL3, T9	102.4	15.0	P-3	107.5	17.0	0.953	-2.0
	JUL3, T10	103.0	12.6	P-3	107.5	17.0	0.958	-4.4
	JUL3, T11	110.4	15.4	P-3	107.5	17.0	1.027	-1.6
	MEAN	106.6	14.5				0.992	-2.5

NOTE: NO PROCTOR SAMPLE WAS COLLECTED DURING CONSTRUCTION OF THE TAILINGS LIFT FOR CTTP5.

TABLE 5. CTTP1 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP1/1	JUL3, T2	107.5	19.9	P-6	110.0	18.0	0.977	1.9
	JUL3, T3	109.9	20.0	P-6	110.0	18.0	0.999	2.0
	JUL3, T4	109.6	18.5	P-6	110.0	18.0	0.996	0.5
	JUL3, T5	107.8	19.1	P-6	110.0	18.0	0.980	1.1
CTTP1/2	JUL3, T12	103.8	22.2	P-6	110.0	18.0	0.944	4.2
	JUL3, T13	105.4	19.9	P-6	110.0	18.0	0.958	1.9
	JUL3, T14	106.2	20.1	P-6	110.0	18.0	0.965	2.1
	JUL3, T15	104.1	21.0	P-6	110.0	18.0	0.946	3.0
CTTP1/3	JUL3, T34	107.9	18.5	P-6	110.0	18.0	0.981	0.5
	JUL3, T35	103.2	20.1	P-6	110.0	18.0	0.938	2.1
	JUL3, T36	103.2	21.5	P-6	110.0	18.0	0.938	3.5
	JUL3, T37	101.7	20.8	P-6	110.0	18.0	0.925	2.8
	MEAN	105.9	20.1				0.962	2.1

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP1/1	JUL3, T2	107.5	19.9	P-13	113.0	15.5	0.951	4.4
	JUL3, T3	109.9	20.0	P-13	113.0	15.5	0.973	4.5
	JUL3, T4	109.6	18.5	P-13	113.0	15.5	0.970	3.0
	JUL3, T5	107.8	19.1	P-13	113.0	15.5	0.954	3.6
CTTP1/2	JUL3, T12	103.8	22.2	P-15	109.5	18.5	0.948	3.7
	JUL3, T13	105.4	19.9	P-15	109.5	18.5	0.963	1.4
	JUL3, T14	106.2	20.1	P-15	109.5	18.5	0.970	1.6
	JUL3, T15	104.1	21.0	P-15	109.5	18.5	0.951	2.5
CTTP1/3	JUL3, T34	107.9	18.5	P-6	110.0	18.0	0.981	0.5
	JUL3, T35	103.2	20.1	P-6	110.0	18.0	0.938	2.1
	JUL3, T36	103.2	21.5	P-6	110.0	18.0	0.938	3.5
	JUL3, T37	101.7	20.8	P-6	110.0	18.0	0.925	2.8
	MEAN	105.9	20.1				0.955	2.8

TABLE 6. CTTP2 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP2/1	JUL9, T13	108.6	15.4	P-18	114.0	16.5	0.953	-1.1
	JUL9, T14	106.0	18.4	P-18	114.0	16.5	0.930	1.9
	JUL9, T15	110.0	14.2	P-18	114.0	16.5	0.965	-2.3
	JUL9, T16	111.9	15.5	P-18	114.0	16.5	0.982	-1.0
CTTP2/2	JUL9, T18	104.5	18.7	P-18	114.0	16.5	0.917	2.2
	JUL9, T20	104.3	21.8	P-18	114.0	16.5	0.915	5.3
	JUL9, T21	109.1	16.4	P-18	114.0	16.5	0.957	-0.1
	JUL9, T22	105.6	21.7	P-18	114.0	16.5	0.926	5.2
CTTP2/3	JUL9, T23	108.9	16.8	P-18	114.0	16.5	0.955	0.3
	JUL9, T24	113.2	15.2	P-18	114.0	16.5	0.993	-1.3
	JUL9, T25	112.4	16.0	P-18	114.0	16.5	0.986	-0.5
	JUL9, T26	103.3	18.8	P-18	114.0	16.5	0.906	2.3
	MEAN	108.2	17.4				0.949	0.9

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP2/1	JUL9, T13	108.6	15.4	P-21	112.5	17.5	0.965	-2.1
	JUL9, T14	106.0	18.4	P-21	112.5	17.5	0.942	0.9
	JUL9, T15	110.0	14.2	P-21	112.5	17.5	0.978	-3.3
	JUL9, T16	111.9	15.5	P-21	112.5	17.5	0.995	-2.0
CTTP2/2	JUL9, T18	104.5	18.7	P-18	114.0	16.5	0.917	2.2
	JUL9, T20	104.3	21.8	P-18	114.0	16.5	0.915	5.3
	JUL9, T21	109.1	16.4	P-18	114.0	16.5	0.957	-0.1
	JUL9, T22	105.6	21.7	P-18	114.0	16.5	0.926	5.2
CTTP2/3	JUL9, T23	108.9	16.8	P-18	114.0	16.5	0.955	0.3
	JUL9, T24	113.2	15.2	P-18	114.0	16.5	0.993	-1.3
	JUL9, T25	112.4	16.0	P-18	114.0	16.5	0.986	-0.5
	JUL9, T26	103.3	18.8	P-18	114.0	16.5	0.906	2.3
	MEAN	108.2	17.4				0.953	0.6

TABLE 7. CTTP4 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP4/1	JUL3, T39	113.8	15.5	P-8/9	122.0	12.5	0.933	3.0
	JUL3, T40	115.9	15.4	P-8/9	122.0	12.5	0.950	2.9
	JUL3, T41	113.0	15.8	P-8/9	122.0	12.5	0.926	3.3
	JUL3, T42	116.6	14.2	P-8/9	122.0	12.5	0.956	1.7
CTTP4/2	JUL3, T43	116.3	14.2	P-8/9	122.0	12.5	0.953	1.7
	JUL3, T44	116.9	10.5	P-8/9	122.0	12.5	0.958	-2.0
	JUL3, T45	118.8	11.0	P-8/9	122.0	12.5	0.974	-1.5
	JUL3, T46	118.3	12.5	P-8/9	122.0	12.5	0.970	0.0
CTTP4/3	JUL3, T47	118.7	12.8	P-8/9	122.0	12.5	0.973	0.3
	JUL3, T48	117.8	13.3	P-8/9	122.0	12.5	0.966	0.8
	JUL3, T49	120.0	12.6	P-8/9	122.0	12.5	0.984	0.1
	JUL3, T50	116.4	13.6	P-8/9	122.0	12.5	0.954	1.1
	MEAN	116.9	13.5				0.958	1.0

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP4/1	JUL3, T39	113.8	15.5	P-8/9	122.0	12.5	0.933	3.0
	JUL3, T40	115.9	15.4	P-8/9	122.0	12.5	0.950	2.9
	JUL3, T41	113.0	15.8	P-8/9	122.0	12.5	0.926	3.3
	JUL3, T42	116.6	14.2	P-8/9	122.0	12.5	0.956	1.7
CTTP4/2	JUL3, T43	116.3	14.2	P-17	120.5	13.5	0.965	0.7
	JUL3, T44	116.9	10.5	P-17	120.5	13.5	0.970	-3.0
	JUL3, T45	118.8	11.0	P-17	120.5	13.5	0.986	-2.5
	JUL3, T46	118.3	12.5	P-17	120.5	13.5	0.982	-1.0
CTTP4/3	JUL3, T47	118.7	12.8	P-16	120.0	13.0	0.989	-0.2
	JUL3, T48	117.8	13.3	P-16	120.0	13.0	0.982	0.3
	JUL3, T49	120.0	12.6	P-16	120.0	13.0	1.000	-0.4
	JUL3, T50	116.4	13.6	P-16	120.0	13.0	0.970	0.6
	MEAN	116.9	13.5				0.967	0.5

TABLE 8. CTTP5 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP5/1	JUL9, T1	91.5	29.2	P-4	97.5	25.0	0.938	4.2
	JUL9, T2	87.0	33.1	P-4	97.5	25.0	0.892	8.1
	JUL9, T3	89.7	30.5	P-4	97.5	25.0	0.920	5.5
	JUL9, T4	94.6	27.8	P-4	97.5	25.0	0.970	2.8
CTTP5/2	JUL9, T5	92.0	28.5	P-4	97.5	25.0	0.944	3.5
	JUL9, T6	99.8	24.1	P-4	97.5	25.0	1.024	-0.9
	JUL9, T7R	98.6	25.0	P-4	97.5	25.0	1.011	0.0
	JUL9, T8	92.2	29.6	P-4	97.5	25.0	0.946	4.6
CTTP5/3	JUL9, T9	94.7	27.7	P-4	97.5	25.0	0.971	2.7
	JUL9, T10	92.7	30.0	P-4	97.5	25.0	0.951	5.0
	JUL9, T11	94.4	27.8	P-4	97.5	25.0	0.968	2.8
	JUL9, T12	99.5	24.3	P-4	97.5	25.0	1.021	-0.7
	MEAN	93.9	28.1				0.963	3.1

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP5/1	JUL9, T1	91.5	29.2	P-4	97.5	25.0	0.938	4.2
	JUL9, T2	87.0	33.1	P-4	97.5	25.0	0.892	8.1
	JUL9, T3	89.7	30.5	P-4	97.5	25.0	0.920	5.5
	JUL9, T4	94.6	27.8	P-4	97.5	25.0	0.970	2.8
CTTP5/2	JUL9, T5	92.0	28.5	P-20	98.0	25.5	0.939	3.0
	JUL9, T6	99.8	24.1	P-20	98.0	25.5	1.018	-1.4
	JUL9, T7R	98.6	25.0	P-20	98.0	25.5	1.006	-0.5
	JUL9, T8	92.2	29.6	P-20	98.0	25.5	0.941	4.1
CTTP5/3	JUL9, T9	94.7	27.7	P-4	97.5	25.0	0.971	2.7
	JUL9, T10	92.7	30.0	P-4	97.5	25.0	0.951	5.0
	JUL9, T11	94.4	27.8	P-4	97.5	25.0	0.968	2.8
	JUL9, T12	99.5	24.3	P-4	97.5	25.0	1.021	-0.7
	MEAN	93.9	28.1				0.961	3.0

APPENDIX A

DAILY FIELD REPORTS

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT

Page 1 of 1

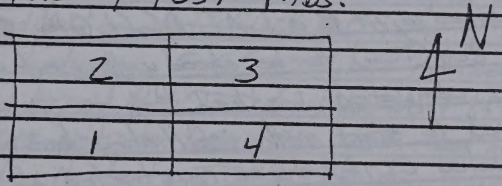
PROJECT LAO/CLARK
JOB NO. 4502
CLIENT ARCO
CONTRACTOR JORDAN
PROJECT MANAGER ARCHIBALD

DATE/TIME: 7/1/96
DAY: S __ M X T __ W __ TH __ F __ S __
WEATHER: Brite Sun X Clear __ Overcast __ Rain __ Snow __
TEMP.: To 32 __ 32-50 __ 50-70 __ 70-85 X 85 up __
WIND: Still __ Moder. X High __
HUMIDITY: Dry __ Moder. X Humid __

FIELD ACTIVITIES:

ARRIVED ON-SITE AT 1210 (ARCHIBALD, SAMPSON). TOOK MOISTURE READINGS ON UNCOMPACTED TEST PAD SUBGRADE. FOUND MATERIALS WELL DRY OF OPTIMUM, ADVISED BOB LASH (JORDAN FOREMAN) TO ADD WATER.

LABELED AREA FOR 4 TEST PADS:



JORDAN ADDED WATER AND BEGAN COMPACTING W/ INGERSOL RAND SP-48 VIBRATORY SHEEPSFOOT. PERFORMED NUMEROUS COMPACTION TESTS - FOUND MATERIAL GENERALLY NEAR DENSITY SPEC BUT WELL DRY OF OPTIMUM MOISTURE. DIRECTED JORDAN PERSONNEL TO ADD MORE WATER. TESTED AGAIN. GENERALLY MET COMPACTION SPEC, BUT STILL WELL DRY OF OPTIMUM. DIRECTED JORDAN TO ADD WATER A THIRD TIME. AGAIN, MET COMPACTION SPEC BUT DRY. AT 1630, ADVISED BOB LASH TO SOAK DOWN BEFORE LEAVING FOR THE DAY. MAKE A PASS WITH COMPACTOR AND WE'D RE-TEST IN AM.

KEN BROCKMAN (B-R. OF REC) ONSITE 1600 - 1645. ERIC JACOBSEN SAID WE WOULD PROCEED WITH TEST PAD CONSTRUCTION TOMORROW. WILL BEGIN LAYING TAILINGS APPROX 8 a.m.

BY Brad Archibald TITLE SR. ENGINEER

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT

Page 1 of 3

DATE/TIME: 7-2-96

DAY: S__ M__ T X W__ TH__ F__ S__

WEATHER: Brite Sun__ Clear X Overcast__ Rain__ Snow__

TEMP.: To 32__ 32-50__ 50-70__ 70-85 X 85 up__

WIND: Still X Moder.__ High__

HUMIDITY: Dry__ Moder.__ Humid__

PROJECT LAO/CLARK
JOB NO. 4502
CLIENT ARCO
CONTRACTOR JCI
PROJECT MANAGER ARCHIBALD

FIELD ACTIVITIES:

8:00AM- Arrived at site with Brad, filling of test pads CTTP3, JCI
tiped one 12" Lift and went on filling CTTP2. In the process
vibratory compaction attempted to compact CTTP3 & sank on the first
pass. JCI cut 18" loose lift down to 12" & attempted to compact
again but was unsuccessfull. After four attempts at compacting CTTP3
a group decision consitting of Brad, Bob, & Eric CTTP3 was abandoned.
10:50AM- CTTP2 was completed with first 8" lift of Tails. CTTP2
was compacted with a CAT D6 (LGP). Two test taken passed
& I told Bob (JCI) to go ahead with next 4" lift. 2nd lift completed
& five tests completed. I asked Bob to wait until after lunch when
Brad returned to start with infiltration barrier layer. After lunch Eric
(ARCO) designated CTTP2 to be constructed of 75% LAO Clays & 25%
decomposed Granit from Hollows pit for infiltration barrier. The
infiltration barrier was mixed Near test pads with JCI loader. This mixture
was then placed on CTTP2 with loader & spread with D6. I was told by
Eric to test for compaction & moisture after first 6" lift was compacted
with D6. This was completed and determined that this mixture was
highly moist and did not pass density tests T39 & T40. After these
test it was determined by BRAD that CTTP2 will be left to
dry over night and attempt to compact & density test the Next day 7-3-96.

BY Pat Sampson TITLE

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DAILY FIELD REPORT (cont'd.)

DATE/TIME: 7-2-96

PROJECT LAO/CLARK

JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

CTTP1 — This test pad was constructed with tails from pit #2 and infiltration barrier consisting of 50% LAO clays and 50% silty sand from Hollows pit as recomended by Eric (ARCO).

Tails were placed in one 12" lift from pit #2 and compacted with CAT D6 (LGP) Low Ground Pressure. After compaction was completed Field Density tests T22 thru T26 concluded that CTTP1 had passed 95% density and approved by Brad as he referenced to plates P2 & P3.

Infiltration barrier layer consisting of 50% LAO clays & 50% silty sand was premixed with JCI Loader near test pads. This layer was placed on CTTP1 with a loader, spread and compacted with D6, in a 9" loose lift that compacted down to between 5-6" lift (Lift thicknesses measured by Bob Lash JCI). Brad advised Bob (JCI) to place next lift alittle thicker and to make sure Not to loose the lath that he was taking measurement from. Field density tests T34 thru T38 concludet that the first lift of CTTP1 were good and they were approved by Brad.

CTTP1 was finished for this day 7-2-96 & will be continued on 7-3-96

Samples taken from CTTP1

CTTP1 - Tails 0-12"
CTTP1 - Lift 1

BY Pat Samps.

TITLE

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Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT (cont'd.)

Page 3 of 3

DATE/TIME: 7-2-96

PROJECT LAO/CLARK
JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

CTTP4 – This test pad was constructed with tails from pit #1 and infiltration barrier layer consisting of 100% silty sand from Hollow's pit @ 90% density.

Tails from pit #1 were placed in CTTP4 in one 12" lift. CTTP4 was compacted in the following order until Field density tests passed

1. 4 Pass CAT D6 (LGP)
2. 4 Pass Roller (No Vibration)
3. 4 Pass CAT D6 (LGP)
4. 4 Pass Roller w/ Vibration

Test T41 thru T44 allowed Brad to approve density of CTTP4

The first layer for infiltration barrier consisting of 100% silty clay was placed in 6" lift. Density tests T45 + T46 were conducted & it was the determine that moisture content was low Bob (JCI) was instructed to wet down tonight and then let it go until tommarow 7-3-96.

CTTP5 – This test pad was constructed by JCI as instructed by Eric (ARCO) because CTTP3 was thrown out.

Tails placed in CTT5 were from pit #2 in first 8" lift. This first lift looked very wet + Density tests T31 thru T33 proved this. This test pad was to dry overnight and be compacted on 7-3-96 as per Brad & Eric (ARCO).

Left site at 4:50. At this time JCI was to spread mixed materials and finish hauling materials to site all work on test pads finished for this day 7-2-96

BY Pat Sampson TITLE

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DAILY FIELD REPORT

Page 1 of 3

DATE/TIME: 7/3/96

PROJECT LAO/CLARK
JOB NO. 4502
CLIENT ARCO
CONTRACTOR JCI
PROJECT MANAGER ARCHIBALD

DAY: S __ M __ T __ W X TH __ F __ S __
WEATHER: Brite Sun __ Clear X Overcast __ Rain __ Snow __
TEMP.: To 32 __ 32-50 __ 50-70 __ 70-85 X am 85 up X pm
WIND: Still __ Moder. X High __
HUMIDITY: Dry __ Moder. X Humid __

FIELD ACTIVITIES:

0730 BOTH CAP MIXTURES (THE 50% LAO CLAYS/50% HOLLOW SILT AND 75% LAO CLAY/25% DG) WERE SPREAD LAST NIGHT TO DRY. BOTH PUSHED BACK INTO STOCKPILES THIS AM.

CTTP1: 50% LAO CLAY/50% HOLLOW SILT. HAD JCI ROLL SURFACE OF LIFT 1 w/ DOZER (CAT D6H LGP) TO PROVIDE UNIFORM SURFACE, HEAL ANY DESSICATION CRACKS FROM OVERNIGHT. CHECKED AND PASSED LIFT 1 BASED ON TESTS T2 - T5.

PLACED 2ND LIFT ON CTTP1 - 9" LOOSE LIFT. COMPACTED w/ D6H LGP DOZER. ~~HAS~~ APPROVED LIFT BASED ON TESTS T12 - T15.

PLACED 3RD LIFT ON CTTP1 - 9" LOOSE LIFT. COMPACTED w/ 4 PASSES OF D6H LGP DOZER. IMMEDIATELY AFTER PLACEMENT AND COMPACTION, MATERIAL MET DENSITY SPEC BUT WAS SLIGHTY TOO WET. AFTER DRYING FOR APPROX. 2HRS, APPROVED 3RD LIFT BASED ON TESTS ~~T~~34 - T37. COVERED COMPLETED PAD WITH ~~A~~ 3" I LIFT OF DECOMPOSED GRANITE AND VISQUENE. SHOT FINAL GRADE ON INFILTRATION BARRIER: THICKNESS 1.5' ± 0.1 FOOT.

CTTP2: 75% LAO CLAYS/25% DECOMPOSED GRANITE. CHECKED MOISTURE CONTENT ON 1ST LIFT (THAT WAS PLACED YESTERDAY). LIFT IS STILL FAR TOO MOIST (T20 - T25). AFTER ATTEMPTING TO RIP

BY BRAD ARCHIBALD TITLE SR. ENGINEER

DAILY FIELD REPORT (cont'd.)

DATE/TIME: 7/3/96

PROJECT LAD/CLARK

JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

THE LIFT TO AID IN DRYING AND SINKING THE GRADER, WE DETERMINED TO ABANDON THE 75% LAD / 25% DG TEST PAD.

CTTP4: 100% HOLLOW SILTY SAND.
RIPPED FIRST LIFT (PLACED YESTERDAY) AND ADDED WATER AT 0745. CHECKED MOISTURE (T6-T7) AND FOUND STILL TOO DRY. WATERED AND CHECKED AGAIN (T15) - STILL TOO DRY. HAD IT RIPPED AND WATERED AGAIN @ 0945. TESTED AGAIN (T30-T32) STILL SLIGHTLY DRY OF OPTIMUM TO +4% SPEC. RIPPED AND ADDED WATER AGAIN. COMPACTED WITH 8 PASSES OF INGERSOLRAND SP-48 SHEEPS FOOT W/ VIBRATOR OFF. MOISTURE 2-3% ABOVE OPTIMUM. SLIGHTLY BELOW TARGET SPEC OF 95% COMPACTION, BUT APPROVED LIFT BASED ON TESTS T39-42. COMPACTED LIFT THICKNESS EQUAL 6" ±.

PLACED LIFT 2 @ 1325. ADDING WATER AS SPREADING MATERIAL. COMPACTED LIFT W/ 4 PASSES OF IR SP-48 WITH VIB. OFF. 2 OF 4 TESTS SHOWED MATERIAL SLIGHTLY DRY OF OPTIMUM, BUT ALL MET TARGET DENSITY OF 95%. APPROVED LIFT.

PLACED LIFT 3 @ 1620. ADDING AS MUCH WATER AS POSSIBLE DURING SPREADING. COMPACTED LIFT W/ 4 PASSES OF SP-48 W/ VIB. OFF. APPROVED LIFT BASED ON TESTS T47-T50. FINAL THICKNESS OF INF. BARRIER MATERIALS EQUAL 1.5 TO 1.6 FEET. PLACED 3" ± OF DECOMPOSED GRANITE AND VISQUENE OVER COMPLETED PAD.

BY BRAD ARCHIBALD TITLE SR ENGINEER

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DAILY FIELD REPORT (cont'd.)

Page 3 of 3

DATE/TIME: 7/3/96

PROJECT LAO/CLARK

JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

CTTP5: APPROVED TAILINGS LIFT, WHICH HAD BEEN TOO WET YESTERDAY. HAD APR DRIED OVERNIGHT. APPROVED @ 0910 BASED ON TEST T 8–T11. DID NOT PLACE ANY INF. BARRIER MATERIALS ON PAD 5.

MISCELLANEOUS: MEASURED MOISTURE CONTENT IN CLAY STOCKPILE (WHICH HAD BEEN THIN SPREAD OVERNIGHT TO DRY). STILL VERY WET OF OPTIMUM (TESTS T18, 19, 33).

SAMPLES COLLECTED:

CTTP4 - T44	- FROM LOCATION OF T44 FOR MOISTURE (ASTM D2216) ANALYSIS.
CTTP4 - T40	- FROM T40 FOR MOISTURE ANALYSIS
CTTP4 - T 42	FROM T42 FOR MOISTURE ANALYSIS.
CTTP4 - T46	- FROM T46 FOR MOISTURE ANALYSIS
CTTP1 - LIFT 2	COMPOSITE FROM SECOND LIFT PLACED ON CTTP1.
CTTP1 - LIFT 3	COMPOSITE OF 3RD LIFT PLACED ON CTTP1.
CTTP4 - LIFT 2	COMPOSITE OF 2ND LIFT PLACED ON CTTP4.
CTTP4 - LIFT 3	COMPOSITE OF 3RD LIFT PLACED ON CTTP 4.

BY BRAD ARCHIBALD TITLE SR. ENGINEER

Pioneer Technical Services, Inc.
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DAILY FIELD REPORT

Page 1 of 1

DATE/TIME: 7-9-96

DAY: S __ M __ T X W __ TH __ F __ S __
WEATHER: Brite Sun __ Clear X Overcast __ Rain __ Snow __
TEMP.: To 32 __ 32-50 __ 50-70 __ 70-85 X 85 up __
WIND: Still __ Moder. X High __
HUMIDITY: Dry __ Moder. __ Humid __

PROJECT LAO/Clark
JOB NO. 4502
CLIENT ARCO
CONTRACTOR JCI
PROJECT MANAGER ARCHIBALD

FIELD ACTIVITIES:

Before I arrived at LAO CTTP2 was cleared of old infiltration barrier material that was in place from a previous ~~[illegible]~~ a test. CTTP2 was assigned to be covered with 50% Peat & 50% decomposed granit. This material was dry of optimum in the stock pile which was tested for moisture. Bob Lash (JCI) watered material as it was being spread with CAT D6 (LGP). The target of 90-95% for compaction was achieved on the first lift determined by Nuclear Gauge Density Tests T13 thru T16. Bob Lash was told this target from Eric (ARCO) by cell-phone. The next two lifts were placed in sequence and both were watered as the lifts were being placed. Lift #2 was checked by Density Tests T17 thru T22 and Lift #3 was checked by T23 thru T26. All Lifts on CTTP2 passed targeted compaction by being compacted by CAT D6 (LGP) with four passes. CTTP2 was then covered with visqueen and approximately one inch of sand over the visqueen.

CTTP5 was completed with 100% Peat as the infiltration barrier. Target compaction for CTTP5 was the same as CTTP2 (between 90-95%) This material Needed no additional moisture because it was very wet when excavated and allowed to dry from the previous week.

The first lift was field Density tested (T1 thru T4) and compaction was achieved. The second lift ~~[illegible]~~ and third lift were also tested in sequence after placement and compaction (2nd Lift T5-T8) (3rd T9-T12). All Lifts passed target compaction.

Composite samples from CTTP2 and CTTP5 were taken from each Lift of these two test pads. These two test pads were constructed alittle smaller than previous because Bob (JCI) asked to cut them by about five feet, he was worried about not having enough material. I told him that it was OK.

BY Pat Semple TITLE ____________

APPENDIX B

FIELD DENSITY TEST RESULTS

7/1/96

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

FIELD DENSITY TEST SUMMARY

90% = 106.7 pcf

Project LAU/CLARK
Project No. 4502
Tests on TEST PAD SUBGRADE, 0-6"
Page 1 of 2

	Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
MSE	1	7-1-96	NG	3.73	110.7	106.7	P-1	118.5	9	90	UNCOMPACTED TEST
PION.	2			12.95	110.5	97.9					PAD SUBGRADE MOISTURE TESTS FOR BAR
1S MSE	3			3.29	116.8	112.4					LASH TO DETERMINE IF WATERING NECESSARY
1S PION	4			9.53	118.4	108.1	MOISTURE SAMPLES				BEFORE COMPACTION, USING PIONEER'S
1N MSE	5			4.45	121.0	115.9	TO BRAUN, 7/1/96				AND MSE'S GAUGE
1N PION.	6			8.74	117.6	108.2					FOR COMPARISON.
2S MSE	7			3.38	111.9	108.2					
2S PION.	8			7.31	109.2	101.7					
2N MSE	9			2.98	113.4	110.1					
PION	10P	7/1/96	NG	2.29	117.0	114.4	P-1	118.5	96.5	90	2N AFTER 3 PASSES W/ IR SP-48
MSE	10m			4.3	114.6	109.9	P-1	118.5	92.7	90	2N "
	11P			2.09	116.3	113.9	P-1	118.5	96.1	90	2S
	11M			4.02	113.0	108.7	P-1	118.5	91.7	90	"
	12M			4.4	109.9	105.3	P-1	118.5	88.9	90	1SE AFTER WATER, COMP.
TOLD OPERATOR (BRIAN NELSON) NEEDS MORE WATER.	12P		NG	3.7	110.9	106.9	P-1	118.5	90.2	90	" "
	13P			4.85	121.9	116.3	P-1	118.5	98.1	90	After 2nd Water, Co
	13M			6.46	121.3	114.0	P-1	118.5	96.2	90	~~1S 4 SOUTH~~ 1 SOUTH
	14M			5.4	126.7	120.2	P-1	118.5	101.4	90	4 SOUTH
	14P			4.02	128.0	123.1	P-1	118.5	103.9	90	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

NOTE: 2 GAUGES USED TODAY BECAUSE OF QUESTIONABLE STANDARD COUNT ON PIONEER GAUGE.

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	FIELD DENSITY TEST SUMMARY	Project LAO/CLARK Project No. 4502 Tests on TESTPAO SUBGRADE, 0-6" Page 2 of 2

	Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
@1330	15M	7/1/96	NG	6.8	118.5	111.0	P-1	118.5	93.7	90	3N - AFTER 2ND WATER ADD.
	15P		NG	4.6	119.5	114.3	P-1	118.5	96.5	90	"
	16M		NG	4.6	115.7	110.6	P-1	118.5	93.3	90	3SE-
	16P		NG	3.4	117.0	113.1	P-1	118.5	95.4	90	3SE
	TOLD OPERATOR TO ADD WATER ONCE MORE.										
	MEASURED A BACKSCATTER MOISTURE @ 2-MID - % MOISTURE = 10.2. WATER IS PRESENT										
	AT SURFACE, JUST NOT PENETRATING.										+CENTRAL BOA
@1405	17M	7/1/96	NG	7.0	121.0	113.1	P-1	118.5	95.4	90	1 CENTRAL
	17P			5.5	122.7	116.2	P-1	118.5	98.1	90	"
	18M			7.8	122.8	113.9	P-1	118.5	96.2	90	4-CENTRAL
	18P			5.4	123.1	116.8	P-1	118.5	98.6	90	"
	19M			6.6	120.0	112.5	P-1	118.5	94.9	90	4-NE
	19P			4.77	121.0	115.5	P-1	118.5	97.5	90	4-NE
	20M			5.5	115.2	109.2	P-1	118.5	92.2	90	3-SOUTH
	20P			3.7	116.4	112.2	P-1	118.5	94.7	90	
	21M			6.3	116.1	109.2	P-1	118.5	92.2	90	3-NW
	21P			4.0	117.5	113.0	P-1	118.5	95.4	90	
	22M			5.5	114.9	109.0	P-1	118.5	92.0	90	2-NORTH
	22P			3.2	116.3	112.7	P-1	118.5	95.1	90	
1645	TOLD BOB LASH, TCI FOREMAN, TO SOAK PADS TONIGHT, ROLL ONCE IN AM, AND WE'D CHECK IN AM										

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
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FIELD DENSITY TEST SUMMARY

P2 - 105.5 -

Project LAO/CLARK
Project No. 4502
Tests on TEST PAD TAILINGS
Page 1 of 3

	Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
MSE	T1-m	7/2/96	NG	17.2	123.8	105.6	P-3	107.5	98.2	95	CTTP3 TAILS, 0-10" 2 PASSES
Pion	T1-P			22.3	123.2	100.7	P3	107.5	93.7	95	
	T2-P			31.14	121.7	92.8	P-3	107.5	86.3	95	" " 4 Pass
	T3-P			30.04	123.1	94.7	P-3	107.5	88.1	95	" " ~~[illegible]~~
	T4-P			25.5	121.6	96.7	P-3	107.5	90.0	95	2 Vib
	T5-P			23.8	118.2	95.4	P-3	107.5	88.7	95	4 Vib
	T6-			26.21	122.9	97.4	P-3	107.5	90.6	95	Pad #4 12" Just Placed
	T7			20.15	124.1	103.3	P-3	107.5	96.1	95	Pad #4 4 Pass No V
	T8			21.62	124.7	102.5	P-3	107.5	95.4	95	Pad #4 Same
	T9			18.27	125.1	105.8	P-3	107.5	98.4	95	#2 No Compaction
	T10			19.04	126.6	106.3	P-3	107.5	98.9	95	" "
	T11			5.79	125.4	118.6	P-1	118.5	100	90	#5 Subgrade
	T12			23.78	125.0	101.0	P-3	107.5	94.0	95	#2 4" Top Lift
	T13			20.55	128.2	106.4	P-3	107.5	99.0	95	" "
	T14			18.61	126.2	106.4	P-3	107.5	99.0	95	" "
	T15			20.99	127.6	105.4	P-3	107.5	98.0	95	" "
	T16			24.55	124.3	99.8	P-3	107.5	92.8	95	" "
	T17			22.19	125.0	102.3	P-3	107.5	95.2	95	#4 CAT. Compaction
	T18			18.22	125.4	106.1	P-3	107.5	98.7	95	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

NOTE: WITH EXCEPTION (T1M) USED PIONEER CPN MC-3 GAUGE ONLY. GOOD STANDARD COUNT(S) ON PIONEER GAUGE TODAY.

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	**FIELD DENSITY TEST SUMMARY** D3 - 101.7	Project LAO/CLARK Project No. L1502 Tests on TEST PADS Page 2 of 3

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T19	7-2-96	NG	18.13	125.5	106.2	P-3	107.5	98.8	95	#4 12"
T20			18.9	130.5	109.8	P-3	107.5	102.1	95	" "
T21			22.28	125.9	102.9	P-3	107.5	95.7	95	" "
T22			17.44	123.1	104.8	P3	107.5	97.5	95	#1 12" Cat Tracked
T23			18.89	123.8	104.1	P-3	107.5	96.8	95	" "
T24			15.38	112.5	101.9	P-3	107.5	94.8	95	" "
T25			22.09	125.0	102.4	P-3	107.5	95.3	95	" "
T26			20.29	124.7	103.7	P-3	107.5	96.5	95	#4 2nd Cat Track
T27			22.01	127.2	104.2	P-3	107.5	96.9	95	" "
T28			18.36	124.2	105.0	P-3	107.5	97.7	95	" "
T29			20.8	125.6	104.0	P-3	107.5	96.7	95	" "
T30			23.8	124.3	101.0	P-3	107.5	94.0	95	" "
T31			23.54	123.7	100.1	P-3	107.5	93.1	95	#5 8" Cat Track
T32			20.8	125.4	103.8	P-3	107.5	96.6	95	" "
T33			27.24	124.3	97.3	P-3	107.5	90.5	95	" "
T34			24.35	128.5	103.3	P-6	110.0	93.9	90-TARGET	#1 6" ½ Peat + ½ Hol
T35			24.37	131.0	105.3	P-6	110.0	95.7	90-TARGET	#1 6" "
T36			22.28	129.7	106.1	P-6	110.0	96.5	90-TARGET	" "
T37			30.95	117.2	89.5	P-6	110.0	81.4	90-TARGET	" "
T38			23.35	129.9	105.3	P-6	110.0	95.7	90-TARGET	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services, Inc.
P.O. Box 3445
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(406) 782-5177

P-8 → 95% = 115.9

FIELD DENSITY TEST SUMMARY

Project LAO / CLARK
Project No. 4502
Tests on TEST PADS
Page 3 of 3

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T39	7-2-96	NG	37.59	119.0	86.5	P-7	103.5	83.6	90-TARG.	#2 1st 6" Lift 75/25
T40			31.13	121.9	92.9	P-7	103.5	89.8	90-TARG.	" "
T41			18.98	128.1	107.6	P-3	107.5	100.1	95	#4 Tails 12" after Compactor
T42			10.91	113.1	102.0	P-3	107.5	94.9	95	" "
T43			39.72	131.3	94.0	P-3	107.5	87.4	95	" "
T44			20.11	124.4	103.6	P-3	107.5	96.4	95	" "
T43 R			18.53	127.2	107.3	P-3	107.5	99.8	95	Retest Near T43
T45			9.44	125.5	114.7	P-8	122.0	94.0	95-TARG.	#4 1st 6" 100% Hollow
T46	7-2-96		11.[illegible]	123.4	111.1	P-8	122.0	91.1	95-TARG.	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	**FIELD DENSITY TEST SUMMARY**	Project LAO/CLARK Project No. 4502 Tests on TEST PADS Page 1 of 3

PIONEER GAUGE

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T1	7-3-96	NG	19.5	127.9	107.0	P-6	110.0	97.3	90 TARG	#1 Lift 1
T2			19.9	128.8	107.5	P-6	110	97.7	90 TARG	#1, LIFT 1, SW CORNER
T3			20.0	131.9	109.9	P-6	110	99.9	90 TARG	#1, LIFT 1, NW CORNER
T4			18.52	129.9	109.6	P-6	110	99.6	90 TARG	#1 Lift 1 SE Corner
T5			19.13	128.4	107.8	P-6	110	98.0	90 TARG	#1 Lift 1 NE C
T6			9.58	126.6	115.5	P-8	122	94.7	95 TARG	#4 Lift 1 N Center
T7			11.7	113.5	101.6	P-8	122	83.3	95 TARG	#4 Lift 1 SE C
T8			15.12	127.3	110.6	P-3	107.5	102.9	95	#5 Tails 0-8" NEC
T9			15.04	117.8	102.4	P-3	107.5	95.3	95	#5 Tails 0-8" NWC
T10			12.55	116.0	103.0	P-3	107.5	95.8	95	#5 Tails 0-8" SWC
T11			15.39	127.4	110.4	P-3	107.5	102.7	95	#5 Tails 0-8" SEC
T12			22.15	126.8	103.8	P-6	110	94.4	90 TARG	#1 Lift 2 SWC
T13			19.85	126.3	105.4	P-6	110	95.8	90 TARG	#1 Lift 2 NWC
T14			20.11	127.5	106.2	P-6	110	96.5	90 TARG	#1 LIFT 2 NEC
T15			21.0	126.0	104.1	P-6	110	94.6	90 TARG	#1, LIFT 2 SEC
T16			10.2	125.9	114.3	P-8/9	122	93.7	95 TARG	#4 LIFT 1, NEC
T17			24.7	122.3	98.1	P-7	103.5	94.8	90 TARG	#2 Lift 1 SEC
T18			58.2	98.1	62.1	P-4/5	97.5		NA	CLAY STOCKPILE
T19			45.5	105.5	72.5	P-4/5	97.5		NA	CLAY STOCKPILE

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

FIELD DENSITY TEST SUMMARY

Project LAO/CLARK
Project No. 4502
Tests on TEST PADS
Page 2 of 3

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T20	7-3-96	NG	19.5	122.0	106.3	P-7	103.5	102.7	90 TARG	#2 Lift 1 SEC
T21			18.2	124.8	105.6	P-7	103.5	102	90 TARG	#2 Lift 1 NEC
T22			24.8	121.6	97.4	P-7	103.5	94.1	90 TARG	#2 Lift 1 NWC
T23			23.4	121.2	98.2	P-7	103.5	94.9	90 TARG	#2 Lift 1 SWC
T24			27.0	121.1	95.4	P-7	103.5	92.2	90 TARG	#2 Lift 1 NWC
T25			23.2	124.5	101.0	P-7	103.5	97.6	90 TARG	#2 Lift 1 N center
T26			21.6	126.1	103.7	P-6	110	94.3	90 TARG	#1 Lift 3 NWC
T27			23.5	124.3	100.7	P-6	110	91.5	90 TARG	#1 Lift 3 SWC
T28			24.4	125.2	100.7	P-6	110	91.5	90 TARG	#1 Lift 3 SEC
T29			22.3	127.9	104.5	P-6	110	95.0	90 TARG	#1 LIFT 3 NEC
T30			12.5	122.6	109.0	P-8	122	89.3	95 TARG	#4, LIFT 1, NWC
T31			12.0	110.5	98.7	P-8	122	80.9	95 TARG	#4 Lift 1 SEC
T32			8.9	111.8	102.6	P-8	122	84.1	95 TARG	#4 Lift 1 NEC
T33			46.5	103.2	70.4					CLAY STOCKPILE
T34			18.5	122.9	107.9	P-6	110	98.1	90 TARG	#1 Lift 3 NWC
T35			20.0	123.9	103.2	P-6	110	93.8	90 TARG	#1 Lift 3 SWC
T36			21.5	125.4	103.2	P-6	110	93.8	90 TARG	#1 Lift 3 SEC
T37			20.8	122.9	101.7	P-6	110	92.5	90 TARG	#1 Lift 3 NEC
T38			12.8	110.8	98.2	P-8	122	80.5	95 TARG	#4 Lift 1 SEC

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

NEC: NORTH EAST CORNER

P-8 = 95% = 115.9
12-16% H_2O

Pioneer Technical Services, Inc.
P.O. Box 3445
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(406) 782-5177

FIELD DENSITY TEST SUMMARY

Project LAO/CLARK
Project No. 4502
Tests on TEST PADS
Page 3 of 3

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T39	5-3-2	NG	15.5	131.5	113.8	P-8/9	122.0	93.3	96 TARG	#4 Lift 1 SEC
T40			15.4	132.5	115.9	P-8/9	122.0	95.0	95 TARG	#4 Lift 1 NEC
T41			15.8	130.9	113.0	P-8/9	122.0	92.6	95 TARG	#4 Lift 1 NWC
T42			14.2	133.2	116.6	P-8/9	122.0	95.6	95 TARG	#4 Lift 1 SWC
T43			14.2	132.8	116.3	P-8/9	122.0	95.3	95 TARG	#4 Lift 2 SEC 4 Passes No
T44			10.5	129.2	116.9	P-8/9	122.0	95.8	95 TARG	#4 Lift 2 SWC "
T45			11.0	131.9	118.8	P-8/9	122.0	97.4	95 TARG	#4 LIFT 2 NWC "
T46			12.5	133.1	118.3	P-8/9	122.0	97.0	95 TARG	#4 LIFT 2 NEC "
T47			12.8	133.9	118.7	P-8/9	122.0	97.3	95 TARG	#4 LIFT 3 NWC, 4 PASSES
T48			13.3	133.4	117.8	P-8/9	122.0	96.6	95 TARG	#4, L3, NEC, "
T49			12.6	135.2	120.0	P-8/9	122.0	98.4	95 TARG	#4, L3, SEC, "
T50			13.6	132.2	116.4	P-8/9	122.0	95.4	95 TARG	#4, L3, SWC, 4"

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	**FIELD DENSITY TEST SUMMARY**	Project LAO/CLARK Project No. 4502 Tests on TEST PADS Page 1 of 2

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T1	3-9-92	NG	29.2	118.2	91.5	P-4	97.5	93.8	90	#5 NE lift 1
T2			33.1	115.8	87.0	P-4	97.5	89.2	90	#5 SW lift 1
T3			30.5	117.1	89.7	P-4	97.5	92.0	90	#5 NW lift 1
T4			27.8	121.0	94.6	P-4	97.5	97.0	90	#5 SE lift 1
T5			28.5	118.2	92.0	P-4	97.5	94.4	90	#5 SE lift 2
T6			24.1	123.9	99.8	P-4	97.5	102.4	90	#5 NE lift 2
T7			21.77	119.1	97.8	P-4	97.5	100	90	#5 NW lift 2
T8			29.6	119.5	92.2	P-4	97.5	94.6	90	#5 SW LIFT 2
T7R			25.0	123.6	98.6	P-4	97.5	101.1	90	RETEST T7.
T9			27.7	120.9	94.7	P-4	97.5	97.1	90	#5 NW LIFT 3
T10			30.0	120.4	92.7	P-4	97.5	95.1	90	#5 SW LIFT 3
T11			27.8	120.6	94.4	P-4	97.5	96.8	90	#5 SE LIFT 3
T12			24.3	123.7	99.5	P-4	97.5	102.1	90	#5 NE lift 3
T13			15.4	125.4	108.6	P-18	114	95.3	90	#2 NE lift 1
T14			18.41	125.5	106.0	P-18	114	93.0	90	#2 SE lift 1
T15			14.2	125.6	110.0	P-18	114	96.5	90	#2 SW lift 1
T16			15.5	129.3	111.9	P-18	114	98.2	90	#2 NW lift 1
T17			24.5	125.7	100.9	P-18	114	88.5	90	#2 NE lift 2
T18			18.7	124.1	104.5	P-18	114	91.7	90	#2 SE lift 2
T19			15.4	127.3	110.4	P-18	114	96.8	90	#2 SW lift 3

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	**FIELD DENSITY TEST SUMMARY**	Project LAO/CLARK Project No. 4502 Tests on TEST PADS Page 2 of 2

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T20	7-9-96	NG	21.8	127.0	104.3	P-18	114	91.5	90	#2 NW Lift 2
T21			16.4	127.0	109.1	P-18	114	95.7	90	Retest T13
T22			21.7	128.6	105.6	P-18	114	92.6	90	Retest T19
T23			16.8	127.2	108.9	P-18	114	95.5	96	#2 NE Lift 3
T24			15.2	130.4	113.2	P-18	114	99.3	90	SE
T25			16.0	130.4	112.4	P-18	114	98.6	90	SW
T26	7-9-96		18.8	122.8	103.3	P-18	114	90.6	90	NW

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

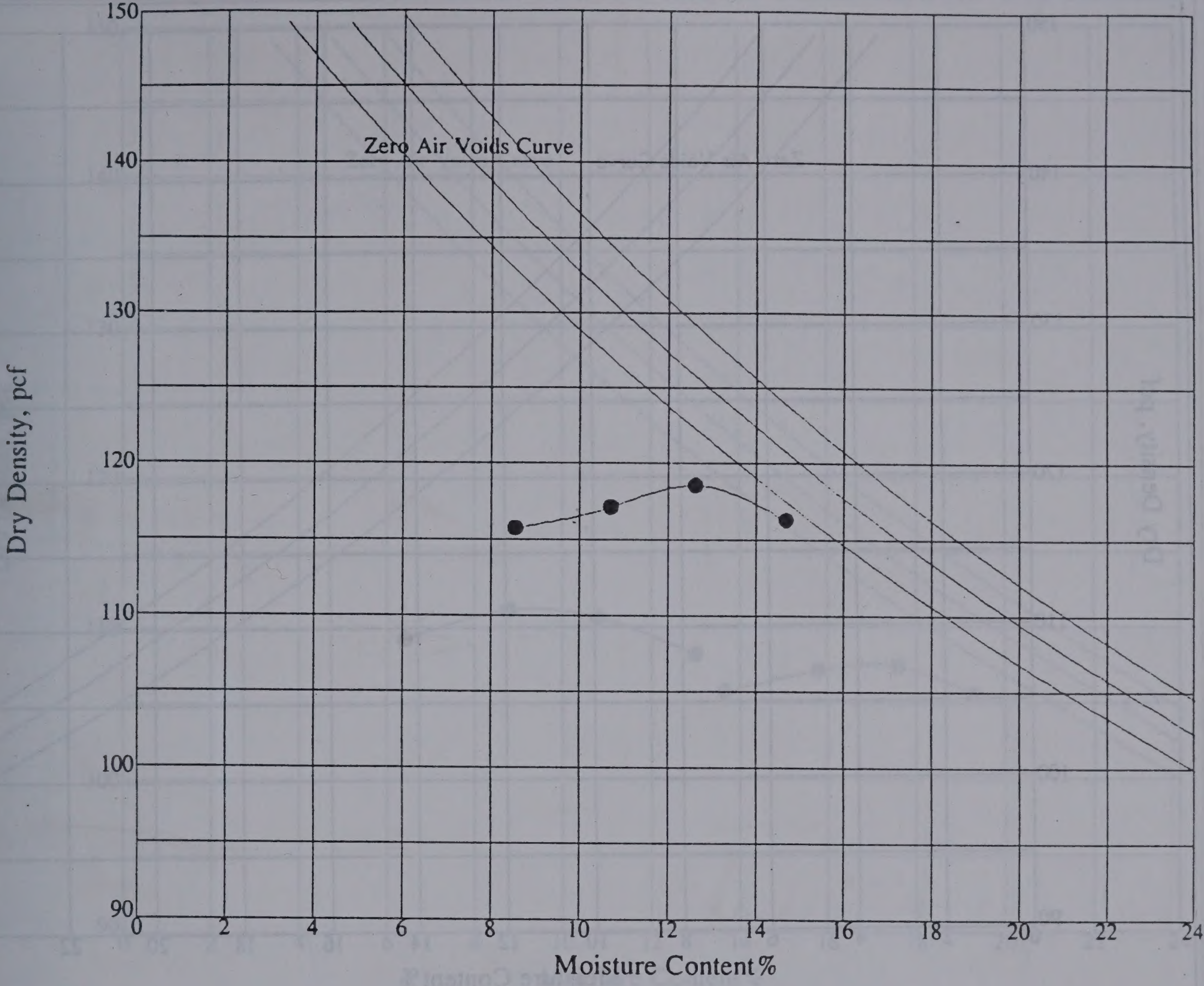
APPENDIX C

MOISTURE-DENSITY RELATIONSHIP CURVES

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	FIELD DENSITY TEST SUMMARY	Project: Lost Creek Project No. 4502 Tests on: [illegible] Page 2 of 2

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T20	[illegible]	NG	21.8	122.0	104.5	P-16	114	91.5	90	#7 NO [illegible]
T21	/	/	16.4	122.0	105.1	P-16	114	95.7	90	Retest T[illegible]
T22			21.2	128.6	105.6	P-16	114	92.6	90	Retest T[illegible]
T23			16.8	122.2	105.9	P-16	114	95.5	90	#2 [illegible]
T24			15.2	130.9	112.2	P-16	114	98.3	90	SF
T25			16.0	130.4	112.4	P-16	114	98.6	90	SCO
T26	5-3-98		15.8	122.8	105.3	P-16	114	92.6	90	NO

* SC = Sandcone Density, NG = Nuclear Gauge Density Test



Sample No: CTTP-Subgrade-1	Lab: 96238	Depth: Unknown	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
			118.5	12.5

Soil Description: POORLY GRADED SAND, fine- to coarse- grained, nonplastic, dark brown. (SP)

10% aggregate retained on the #4 sieve (cumulative).
5% aggregate retained on the 3/8" sieve (discarded).
3% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from LAO Butte Reduction Works.

ASTM D 698-91
Procedure: B

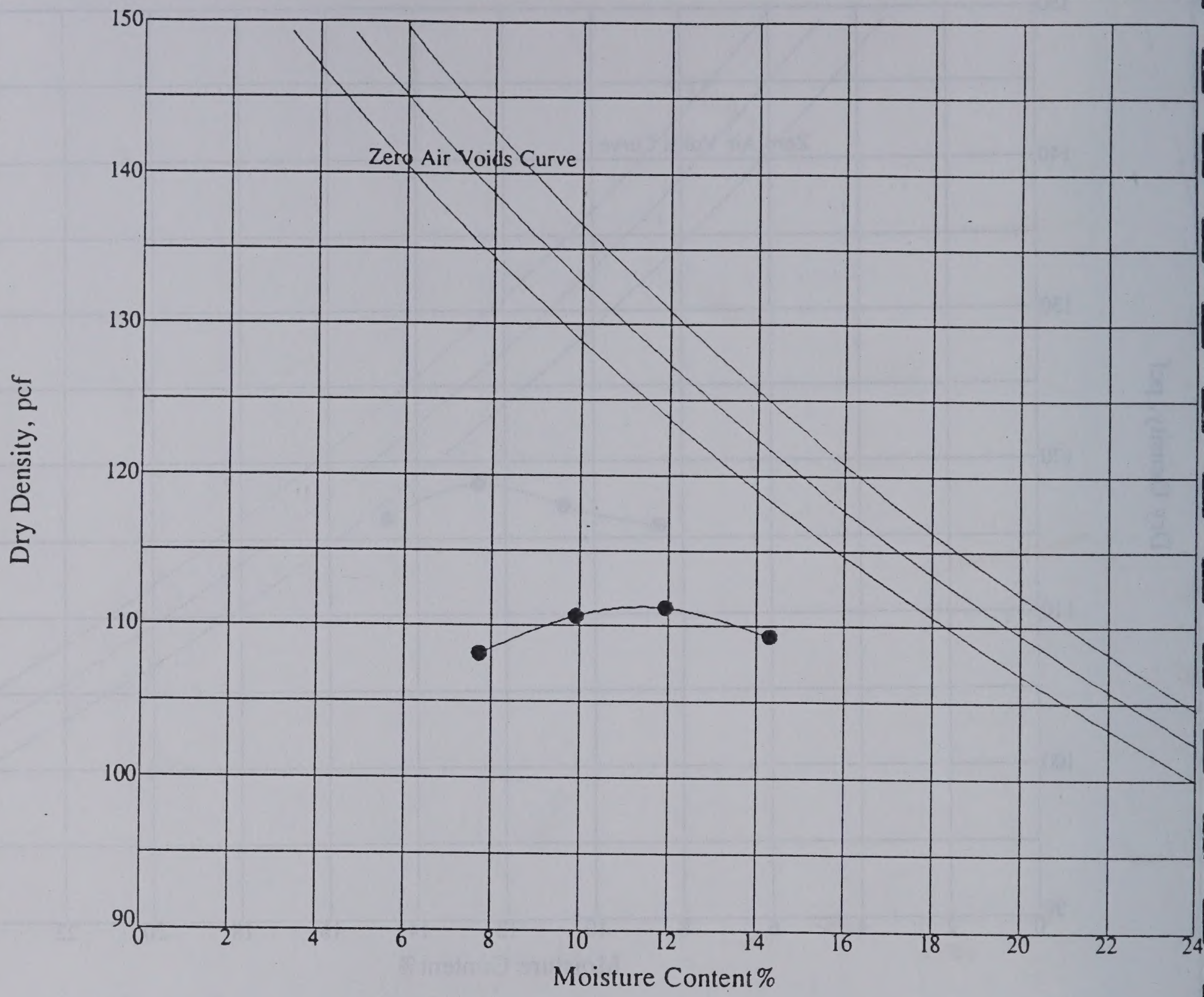
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-1



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-Tails-1	Lab: 96239	Depth: Unknown	111.0	11.5

Soil Description: SILTY SAND, fine- to coarse-grained, nonplastic, mine tailings, olive brown. (SM)

0% aggregate retained on the #4 sieve (discarded).

0% aggregate retained on the 3/8" sieve (discarded).

0% aggregate retained on the 3/4" sieve (discarded).

Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 2.

(PRECON TAILINGS)

ASTM D 698-91

Procedure: A

*Density and moisture results rounded to nearest 0.5.

Job No: BJBX-96-057A

Appr: BAW

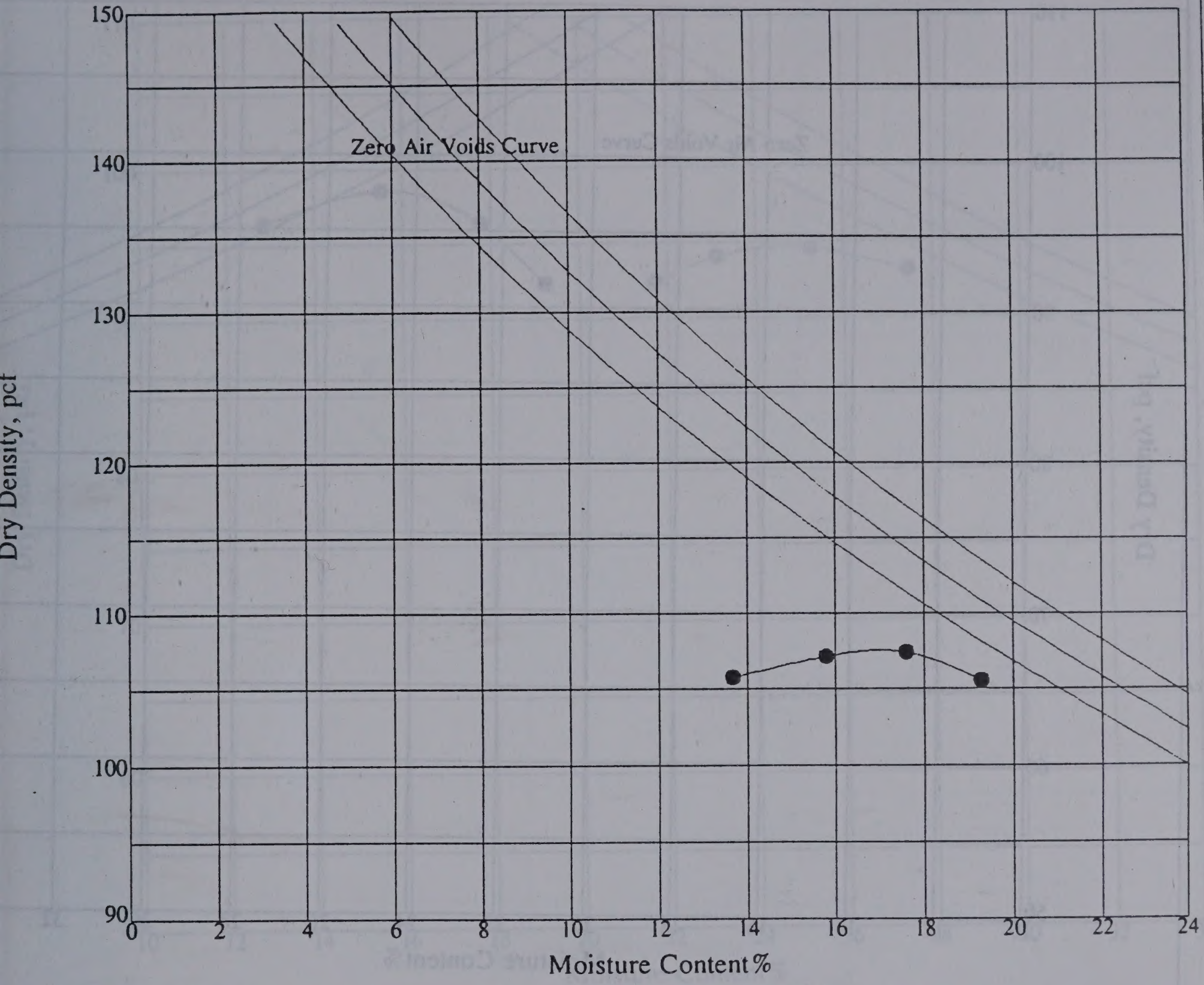
Date: JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate

P-2



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-Tails-2	Lab: 96240	Depth: Unknown	107.5	17.0

Soil Description: POORLY GRADED SAND, fine- to coarse-grained, nonplastic, brown. (SP)
2% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 1.
(PRECON TAILINGS)

ASTM D 698-91
Procedure: A

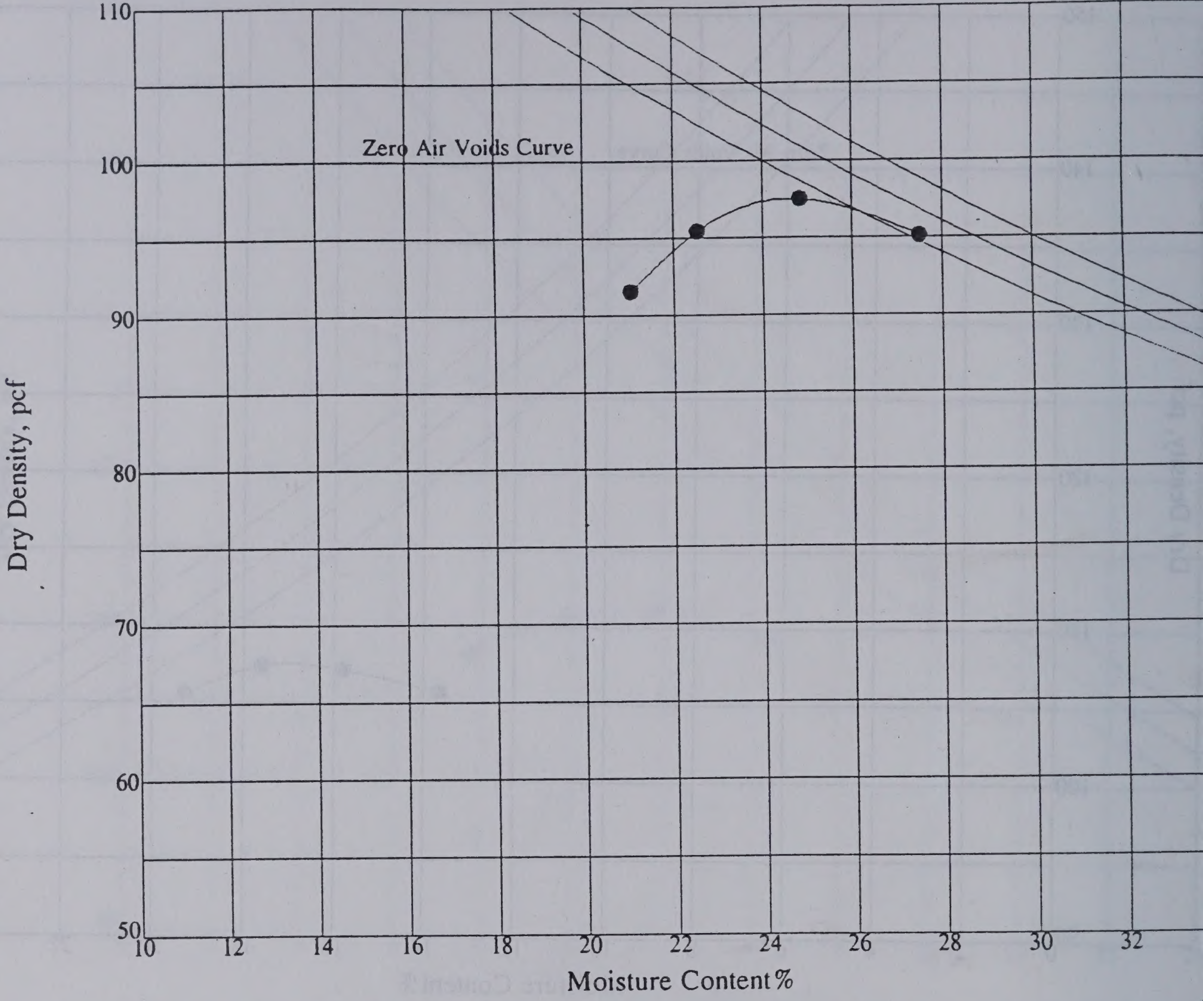
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-3



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-S/C-1 Lab: 96241 Depth: Unknown	97.5	25.0

Soil Description: SANDY LEAN CLAY, fine- to coarse-grained, low plasticity, trace organic, dark brown. (CL)
0% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 2.

ASTM D 698-91
Procedure: A

CTTP5 PRECON

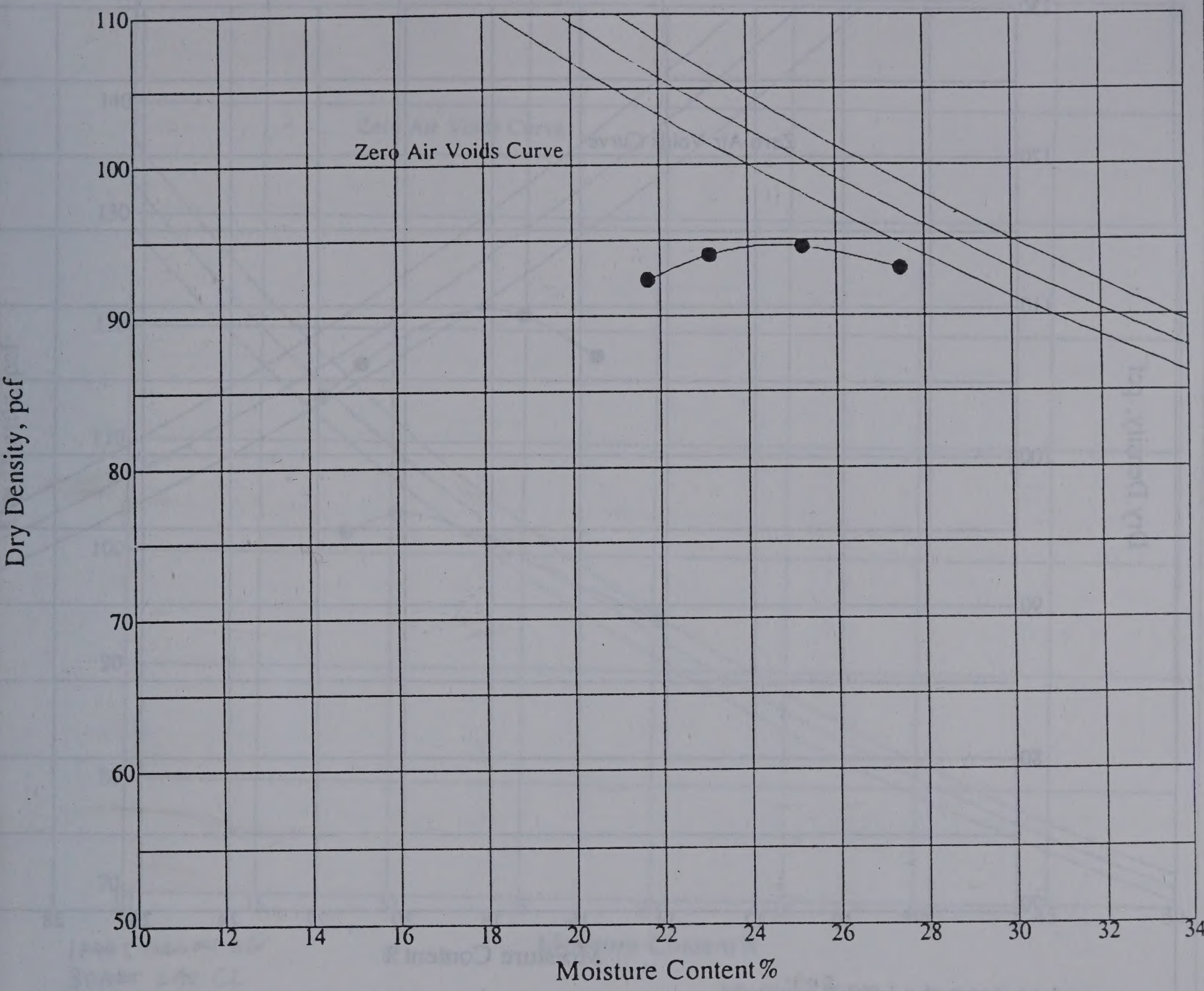
*Density and moisture resul
rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plat
P-



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-S/C-2	Lab: 96242	Depth: Unknown	94.5	25.0

Soil Description: SANDY LEAN CLAY, fine- to coarse-grained, slightly plastic, trace organic, dark brown. (CL)
0% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 1.

ASTM D 698-91
Procedure: A

CTTP5 PRECON

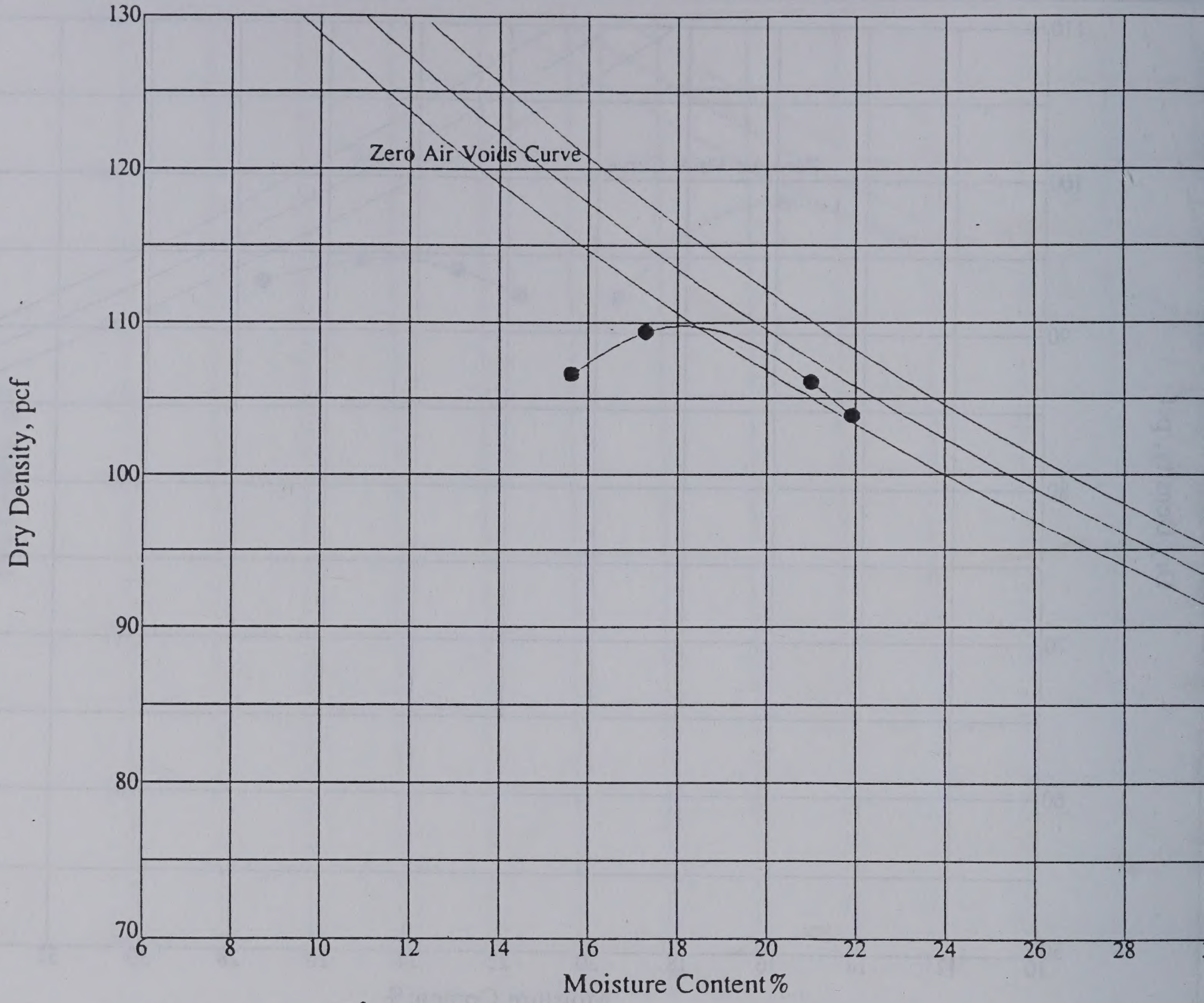
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-5



1 PART HOLLOW SM
1PART LAO CL

	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-1 Lab: 96253 Depth: Unknown	110.0	18.0

Soil Description: CLAYEY SAND, fine- to medium-grained, slightly to low pl., dark brown. (SC)
4% aggregate retained on the #4 sieve (discarded).
1% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/28/96 from LAO.

ASTM D 698-91
Procedure: A

CTTP1 PRECON

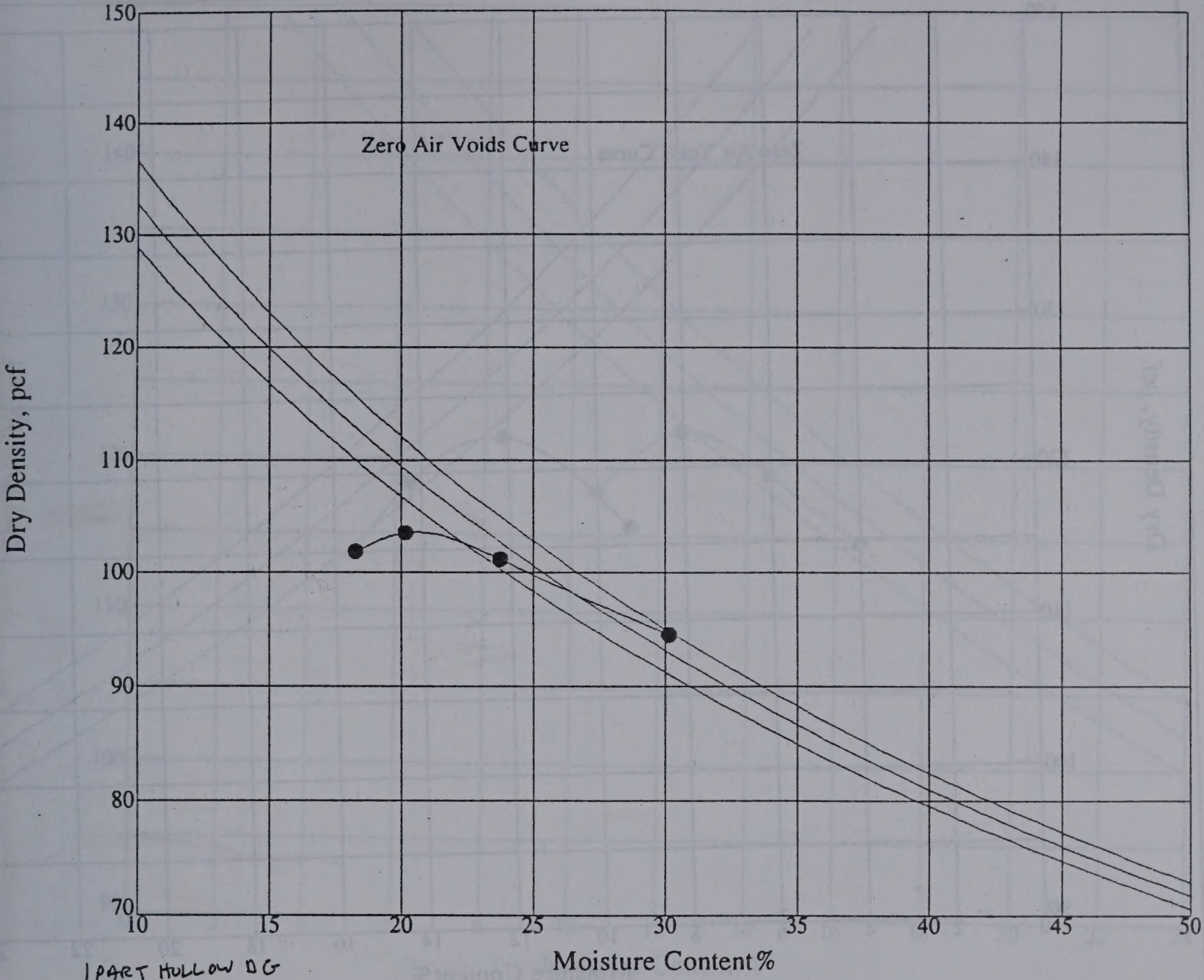
*Density and moisture results
rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
Date:
JUL 1, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-6



1 PART HOLLOW DG
3 PART LAO CL

			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-2	Lab: 96254	Depth: Unknown	103.5	22.0

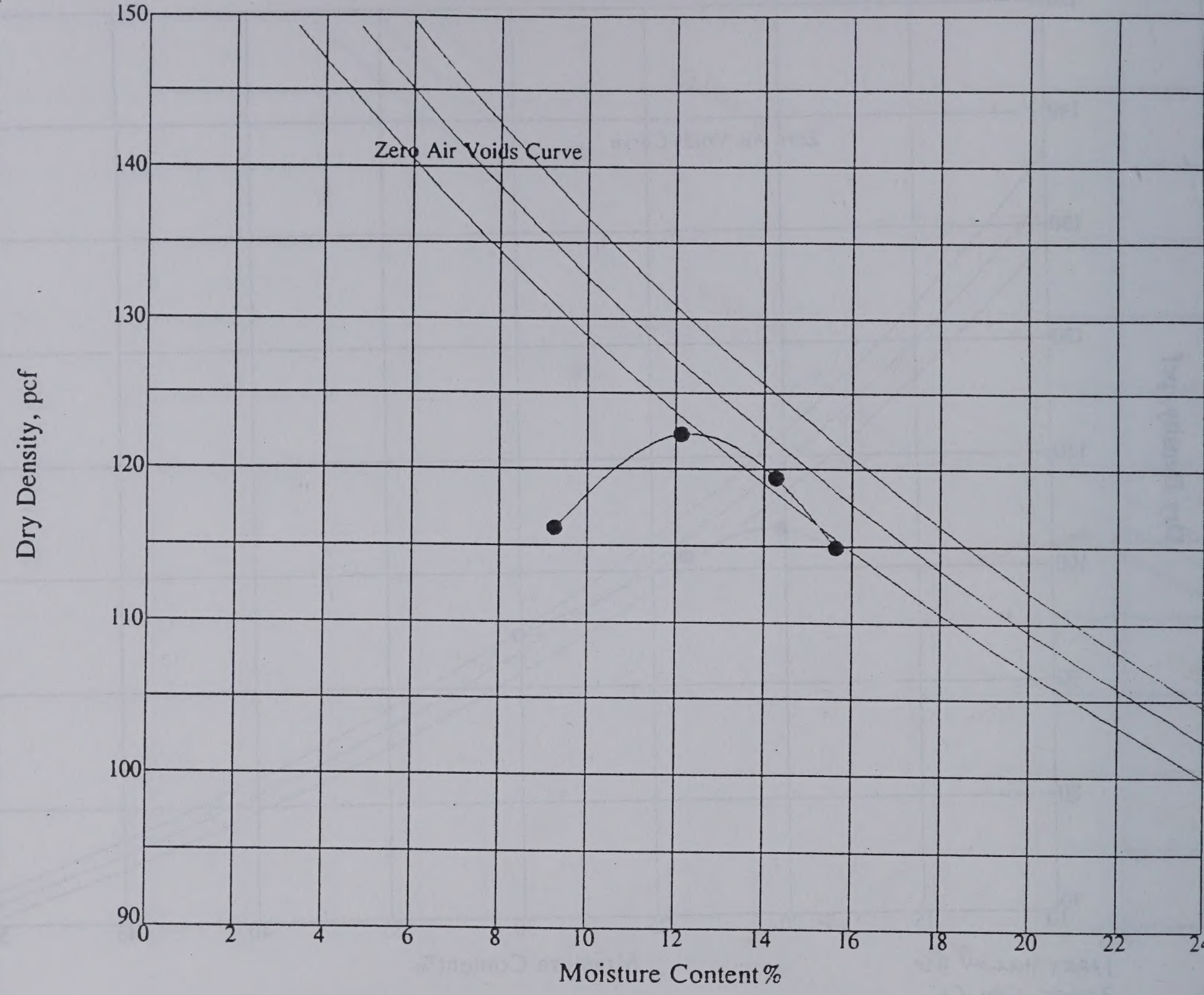
Soil Description: CLAYEY SAND, fine- to medium-grained, slightly to low pl., dark brown. (SC)
4% aggregate retained on the #4 sieve (discarded).
0.4% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/28/96 from LAO.

ASTM D 698-91
Procedure: A

CTTP2 PRECON (75% LAO, 25% DG)

*Density and moisture results rounded to nearest 0.5.

Job No: BJBX-96-057A Appr: WL Date: JUL 1, 1996	Laboratory Compaction Characteristics of Soil (Proctor) LAO/Clark Butte, Montana Braun Intertec Corporation	Plate P-7



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: Hollow Silty Sand - 1	Lab: 96255	Depth: Unknown	122.0	12.5

Soil Description: CLAYEY SAND, fine- to coarse-grained, low plasticity, olive brown. (SC)
5% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from Hollow Pit.

ASTM D 698-91
Procedure: A

CTTP4 PRECON

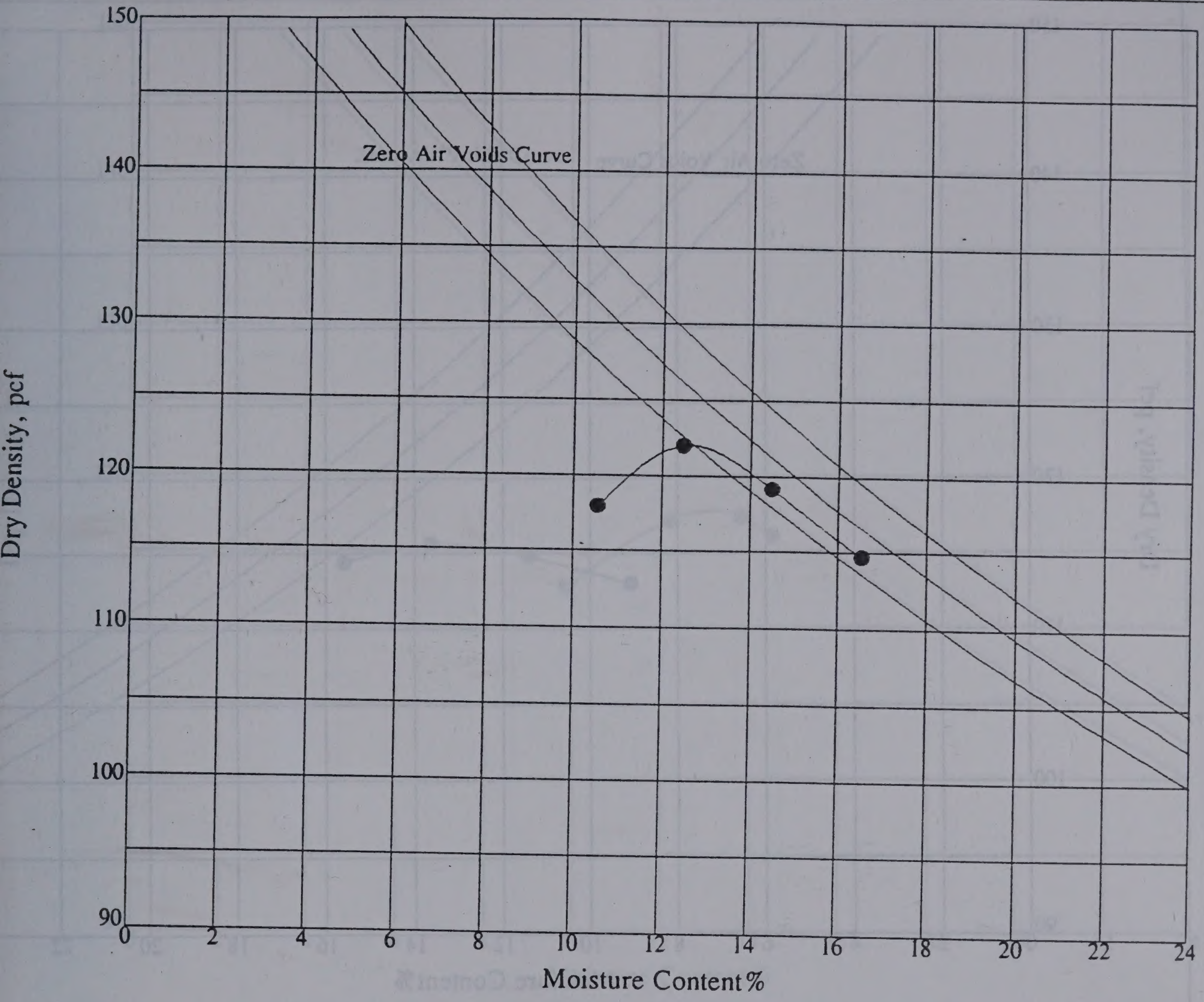
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
Date:
JUL 1, 1996

Laboratory Compaction Characteristics of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-8



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
ample No: 10	Lab: 96256	Depth: Inf. barrier layer	122.0	12.5

oil Description:
SILTY SAND, fine- to -coarse-grained, slightly plastic, reddish brown. (SM)
5% aggregate retained on the #4 sieve (discarded).
1% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 07/01/96 from Hollow Pit, Silt sand-2

(CTTP & PRECON)

STM D 698-91
rocedure: A

*Density and moisture results rounded to nearest 0.5.

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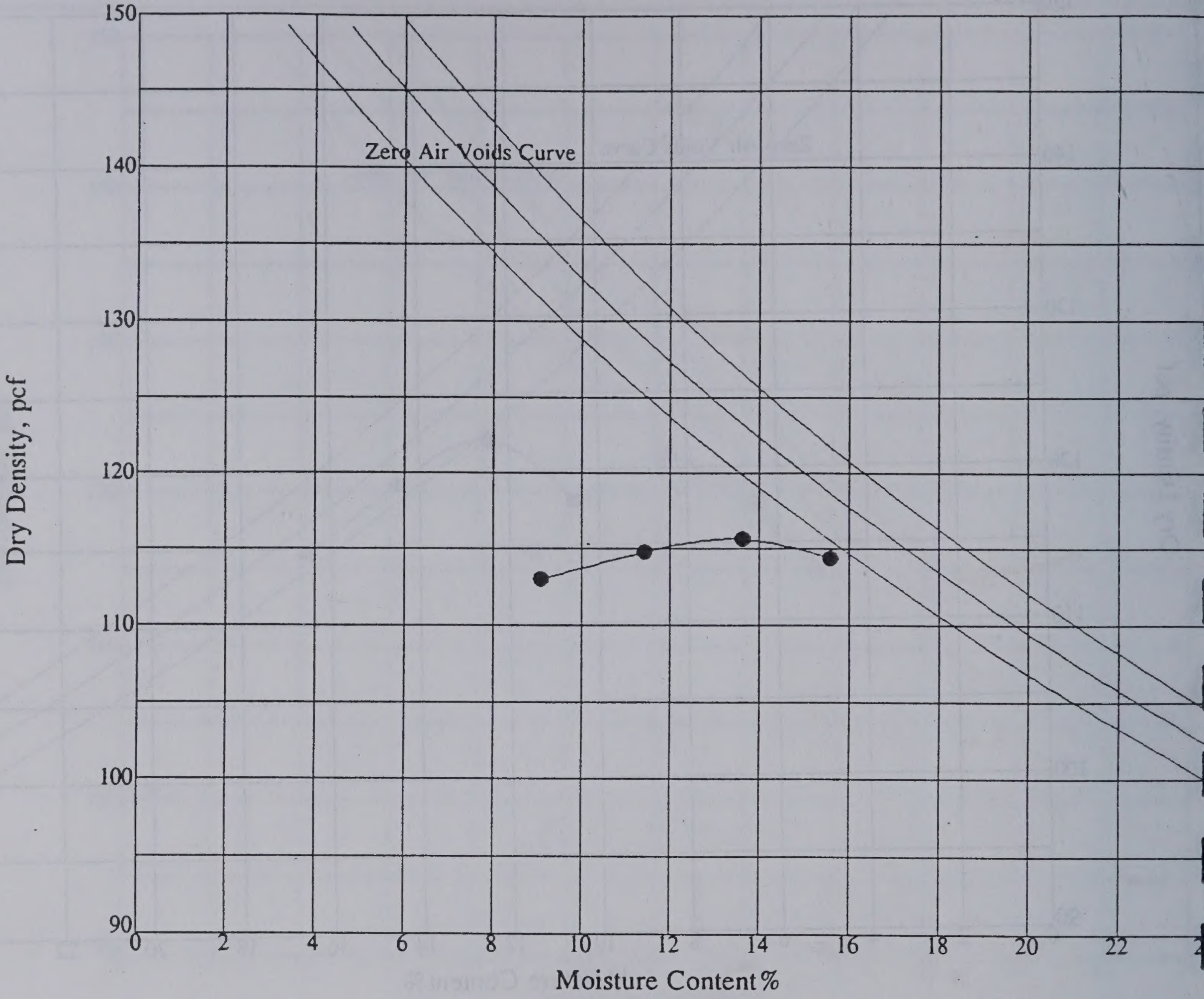
Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-9



Sample No: 15	Lab: 96265	Depth: 0 - 12"	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
			116.0	13.5

Soil Description: SILTY SAND, fine- to medium-grained, nonplastic, dark brown. (SM)

2% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-4. - TAILINGS

ASTM D 698-91
Procedure: A

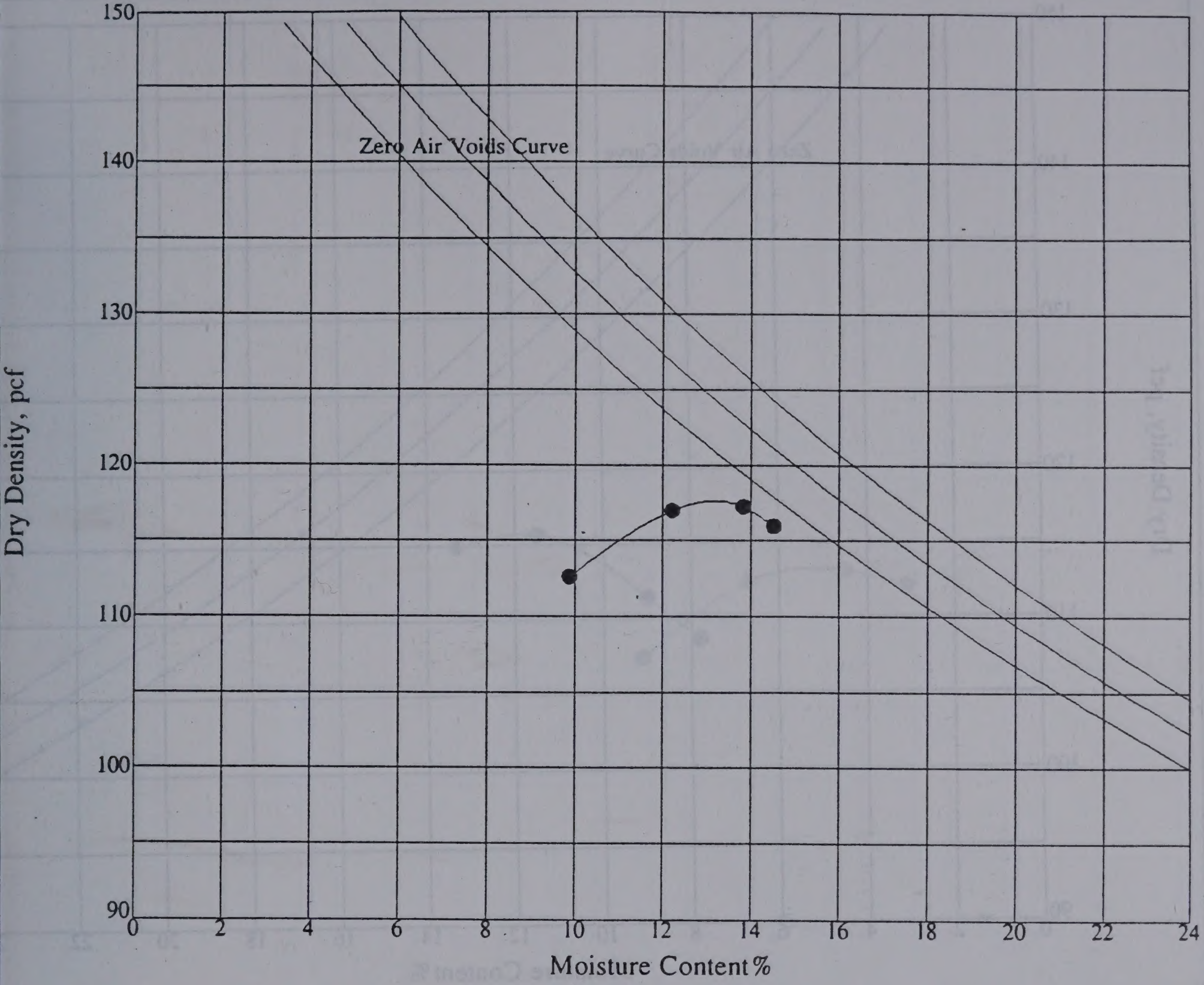
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 9, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-1



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 16	Lab: 96266	Depth: 0 - 12"	117.5	13.0

Soil Description: SILTY SAND, fine- to medium-grained, nonplastic, brown. (SM)

2% aggregate retained on the #4 sieve (discarded).
0.3% aggregate retained on the 3/8" sieve (discarded).
0.2% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-2 - TAILINGS

ASTM D 698-91
Procedure: A

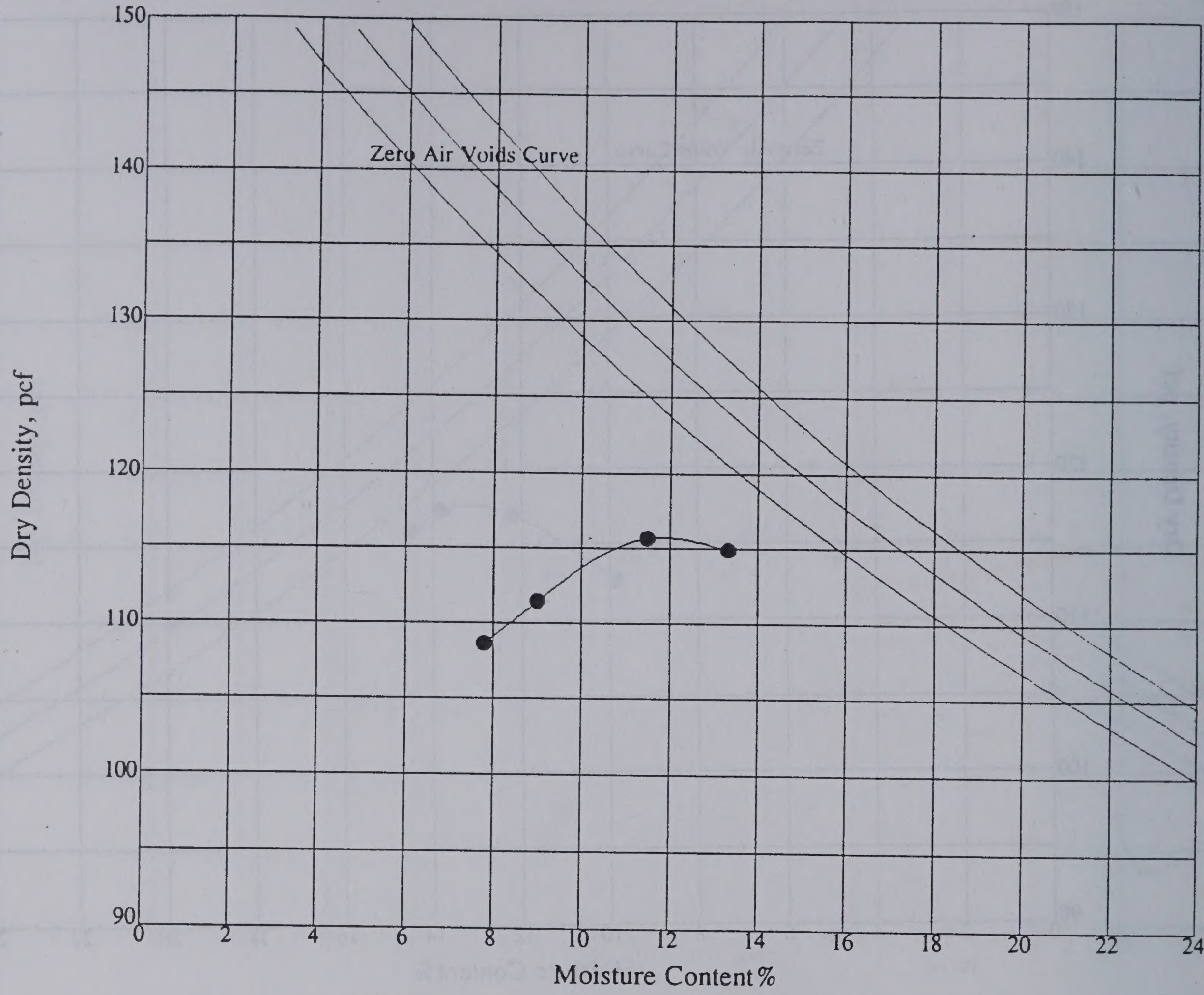
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
Date:
JUL 8, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-11



Sample No: 17	Lab: 96267	Depth: 0 - 12"	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
			116.0	12.0

Soil Description: SILTY SAND, fine- to medium-grained, nonplastic, olive brown.
(SM)
0.2% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-1. TAILINGS

ASTM D 698-91
Procedure: A

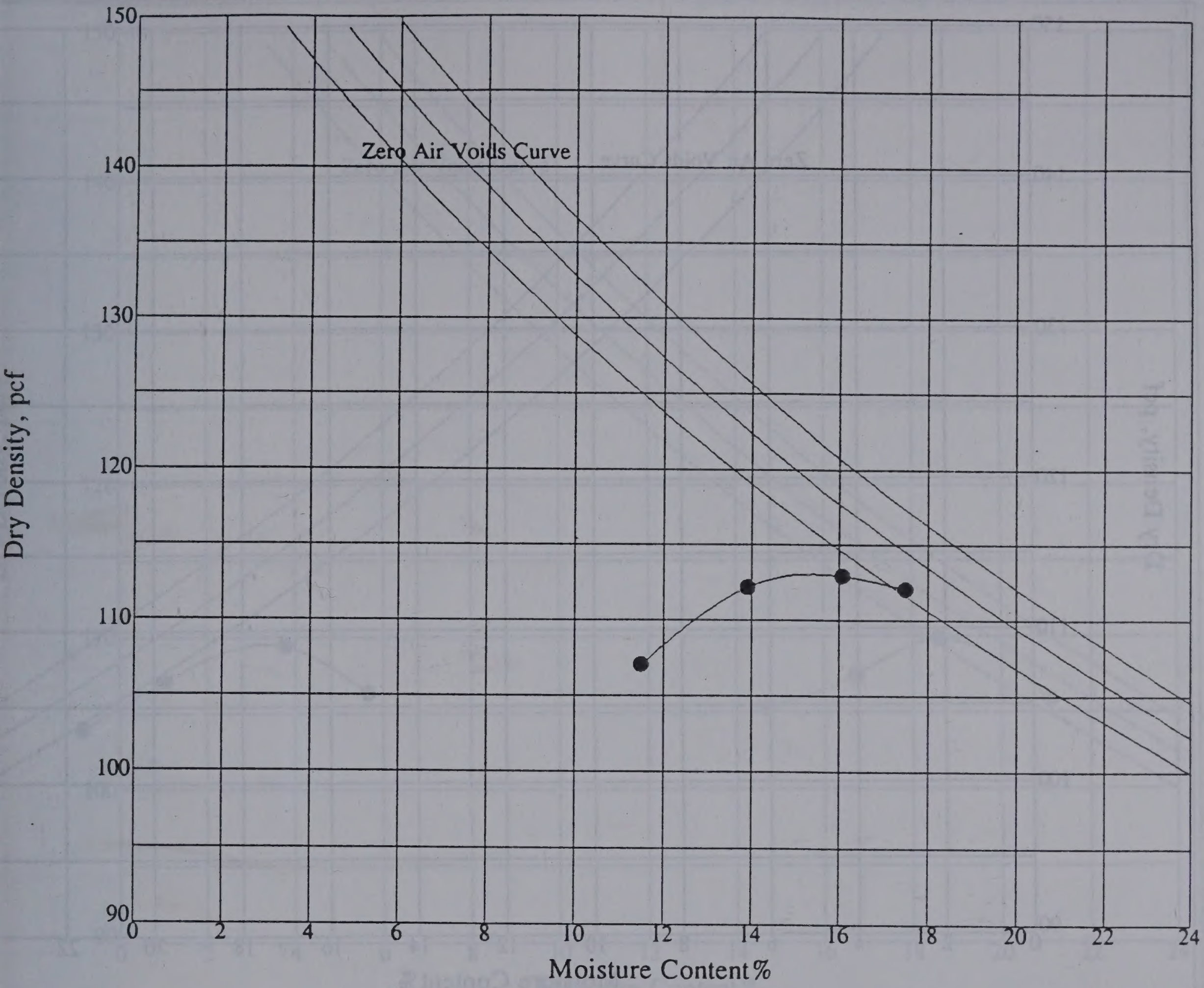
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 5, 1996

Laboratory Compaction Characteristics of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-12



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 18	Lab: 96268	Depth: 0 - 6"	113.0	15.5

Soil Description: SILTY SAND, fine- to medium-grained, slightly plastic, dark brown. (SM)
4.5% aggregate retained on the #4 sieve (discarded).
1.3% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-1. LIFT 1

ASTM D 698-91
Procedure: A

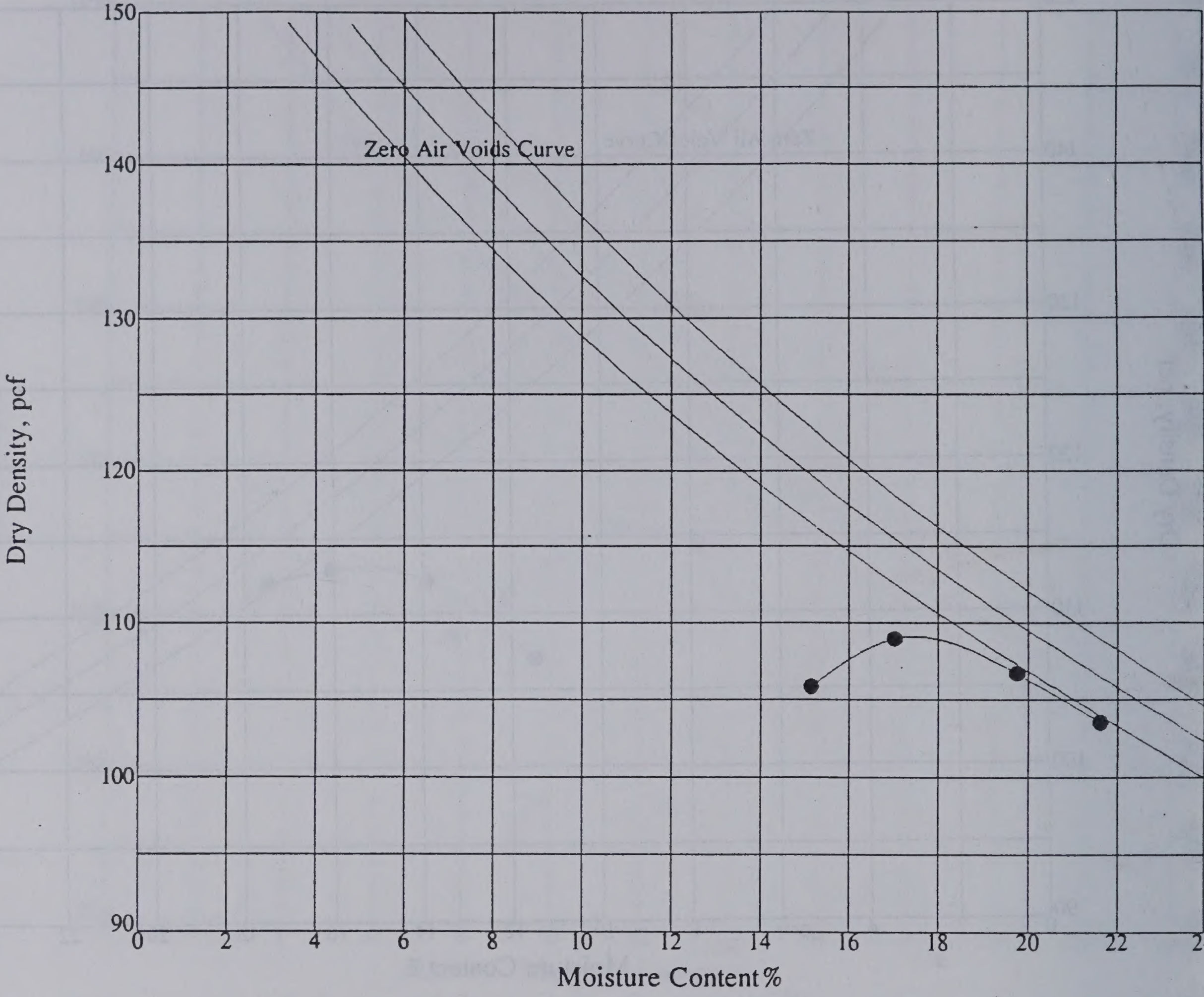
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 9, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-13



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 19 Lab: 96269 Depth: 0 - 6"	109.0	17.5

Soil Description: SILTY SAND, fine- to medium grained, slightly plastic, dark brown. (SM)
5.5% aggregate retained on the #4 sieve (discarded).
0.8% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-2. 75% LAO, 25% DG

ASTM D 698-91
Procedure: A

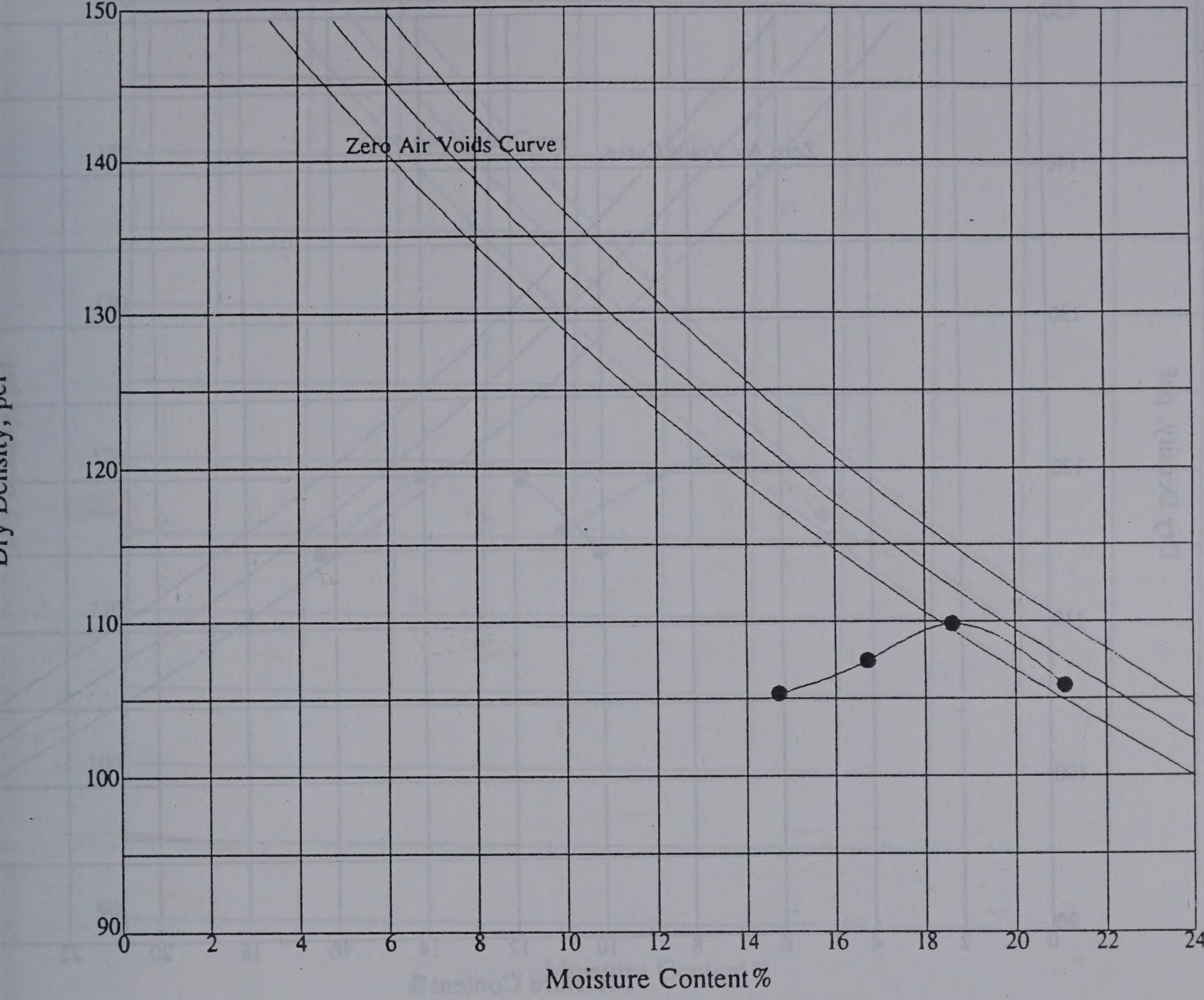
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 9, 1996

Laboratory Compaction Characteristics of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-14



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
ample No: 24 Lab: 96280 Depth: Lift 2	109.5	18.5

oil Description: CLAYEY SAND, fine- to coarse-grained, medium plasticity,
dark brown (SC).
3% aggregate retained on the #4 sieve (discarded).
1% aggregate retained on the 3/8" sieve (discarded).
0% retained on the 3/4" sieve.
Sampled by BOA/PTS on 73/96 from CTTP1, Lift 2.

STM D 698-91
rocedure: A

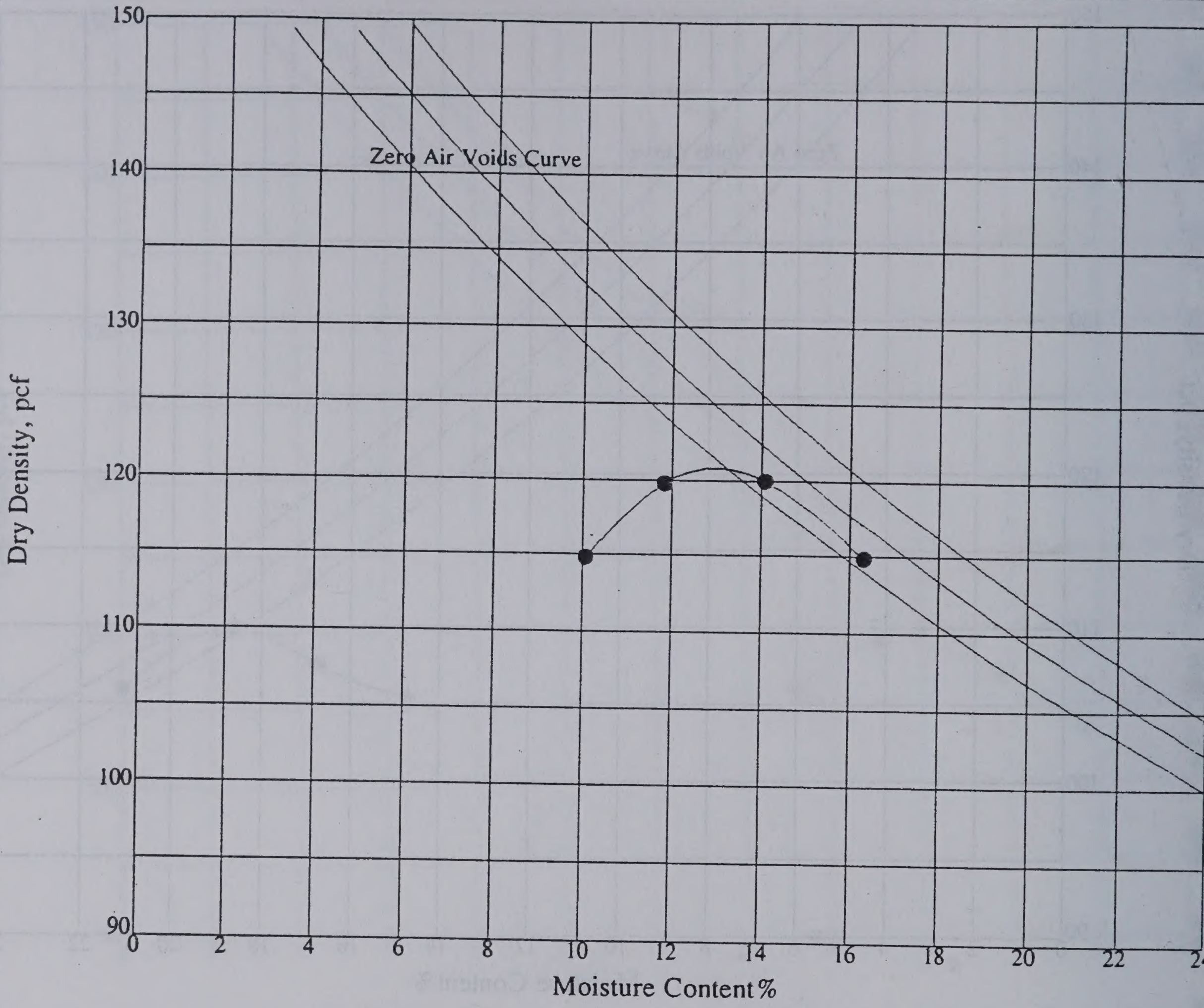
*Density and moisture results rounded to nearest 0.5.

ob No:
BJBX-96-057A
Appr:
Date:
UL 12, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-15



Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
120.0	13.0

Sample No: 25 Lab: 96281 Depth: ~~Lift 2~~

Soil Description: SILTY CLAYEY SAND, fine- to coarse-grained, low plasticity, light brown (SC-SM).
2% aggregate retained on the #4 sieve (discarded).
0.1% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve.
Sampled by BOA/PTS on 7/3/96 from CTTP4, Lift 3.

ASTM D 698-91
Procedure: A

*Density and moisture results rounded to nearest 0.5.

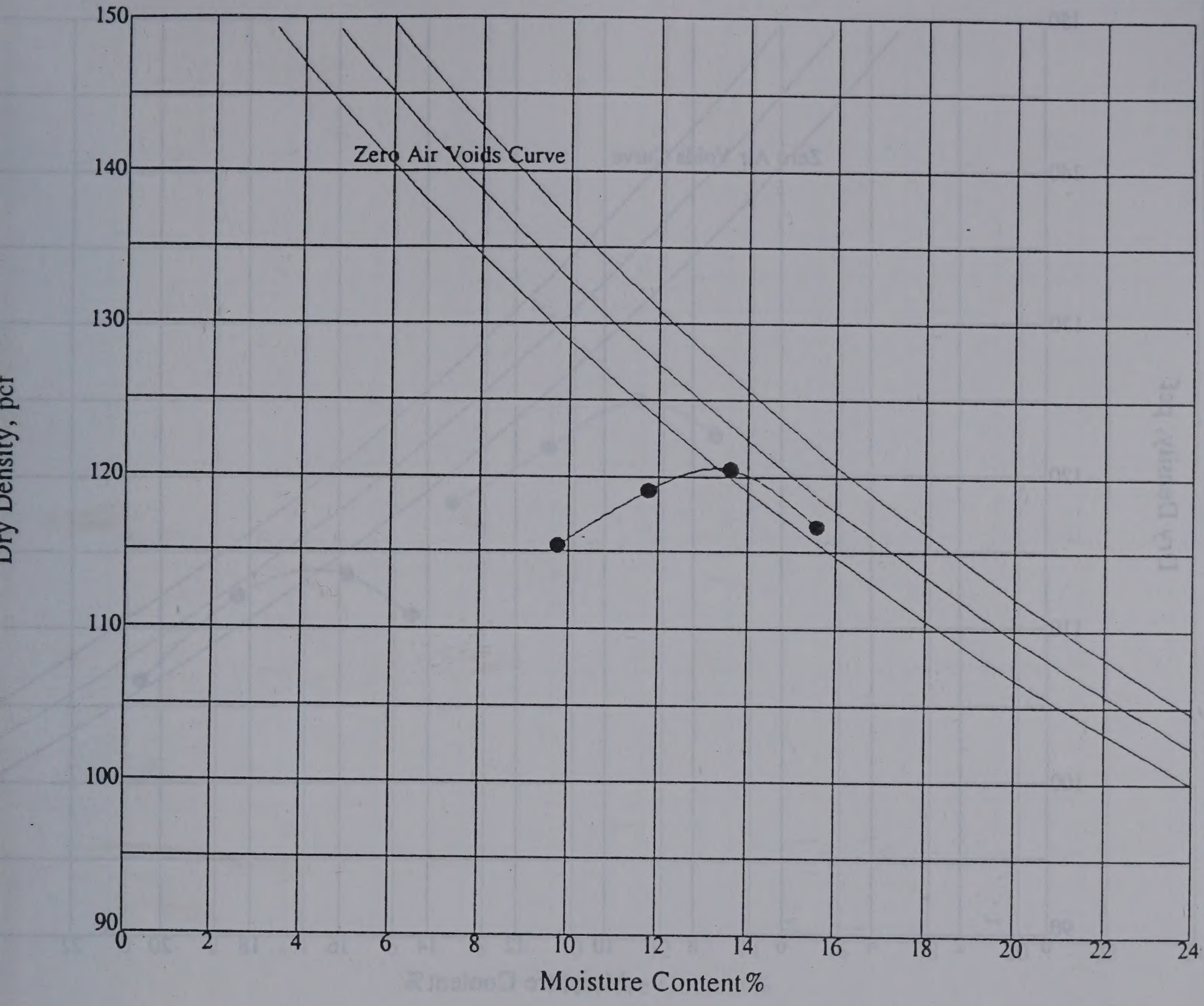
Job No:
BJBX-96-057A
Appr: WPK
Date:
JUL 12, 1996

Laboratory Compaction Characteristics of Soil (Proctor)

LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-16



Maximum Dry Density Weight, pcf*
120.5

Optimum Moisture Content %*
13.5

ample No: 26 Lab: 96282 Depth: Lift 2

oil Description:

CLAYEY SAND, fine- to coarse-grained, low plasticity, brown (SC).
3% aggregate retained on the #4 sieve (discarded).
0.3% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve.
Sampled by BOA/PTS on 7/3/96 from CTTP4, Lift 2.

STM D 698-91
rocedure: A

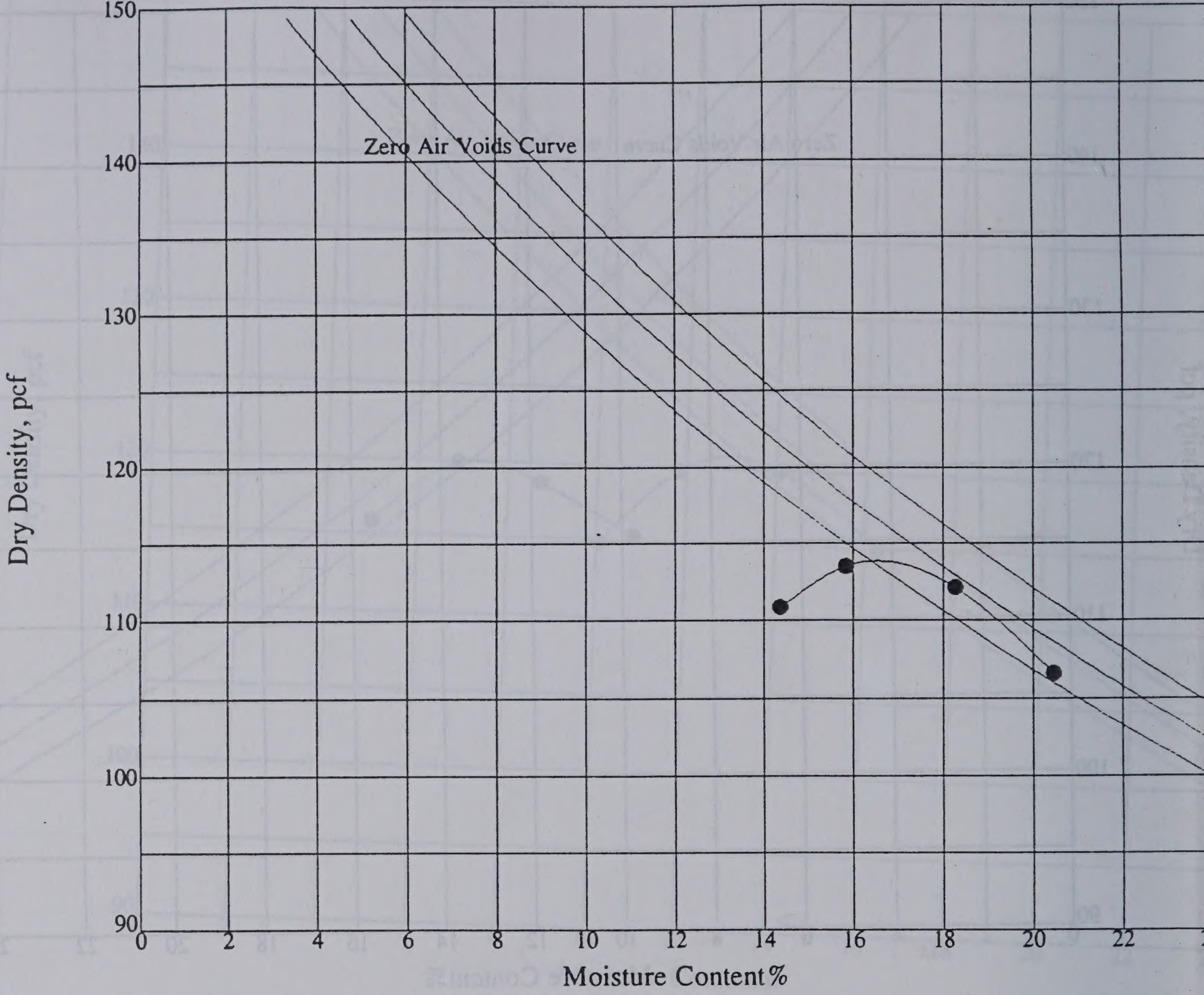
*Density and moisture results rounded to nearest 0.5.

b No:
JBX-96-057A
ppr:
NHL
ate:
JL 12, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-17



Maximum Dry Density Weight, pcf* 114.0

Optimum Moisture Content %* 16.5

Sample No: 27 Lab: 96283 Depth: Not Available (NA)

Soil Description: CLAYEY SAND, fine- to coarse-grained, slightly to low pl., black. (SC)
9% aggregate retained on the #4 sieve (cumulative).
3% aggregate retained on the 3/8" sieve (discarded).
2% aggregate retained on the 3/4" sieve (discarded).
Sampled by DS/ARCO on 07/08/96, 50% Hollow DEC. GRANITE and 50% LAO -CTTP2 PRECON.

ASTM D 698-91
Procedure: B

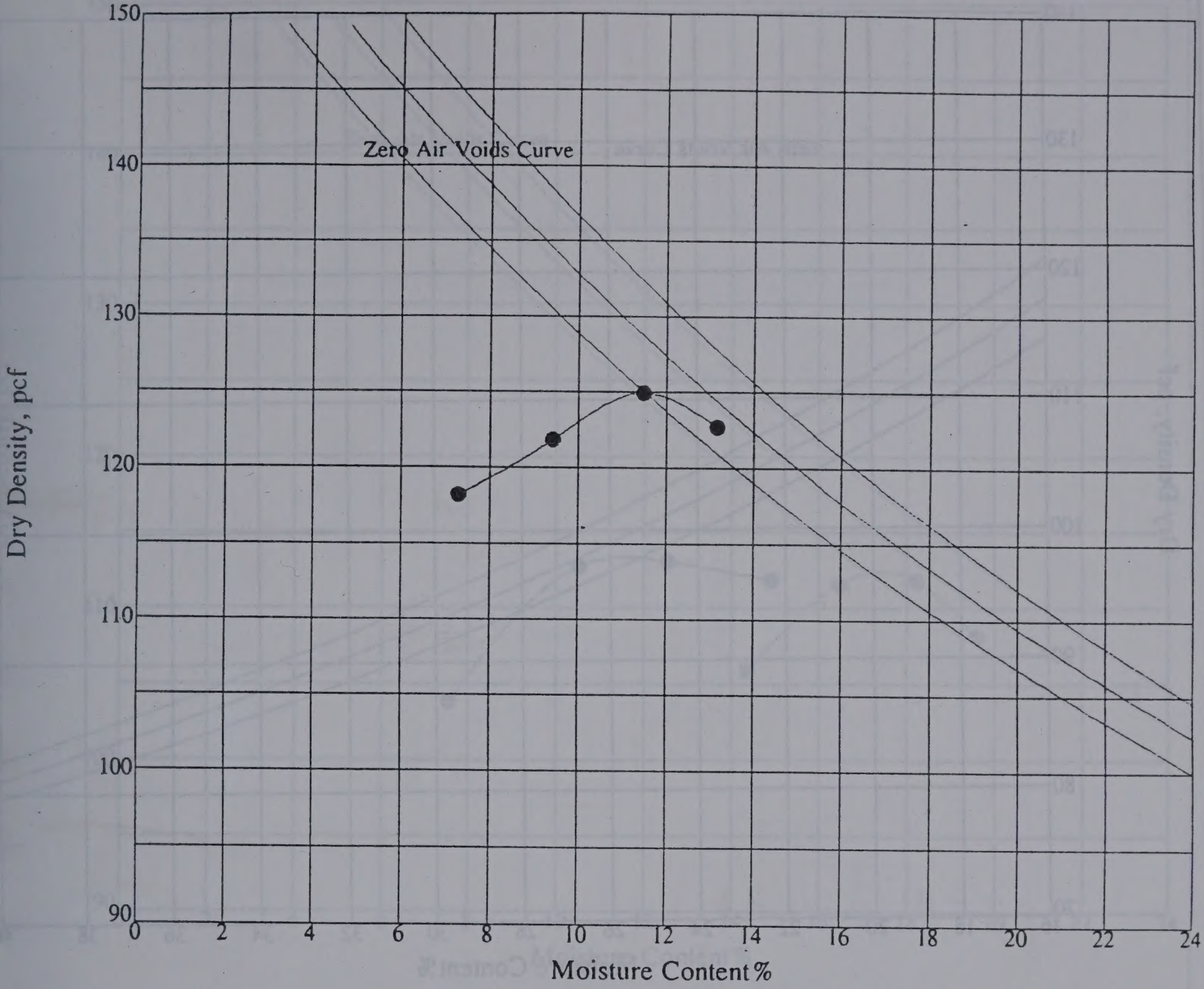
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 9, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-1



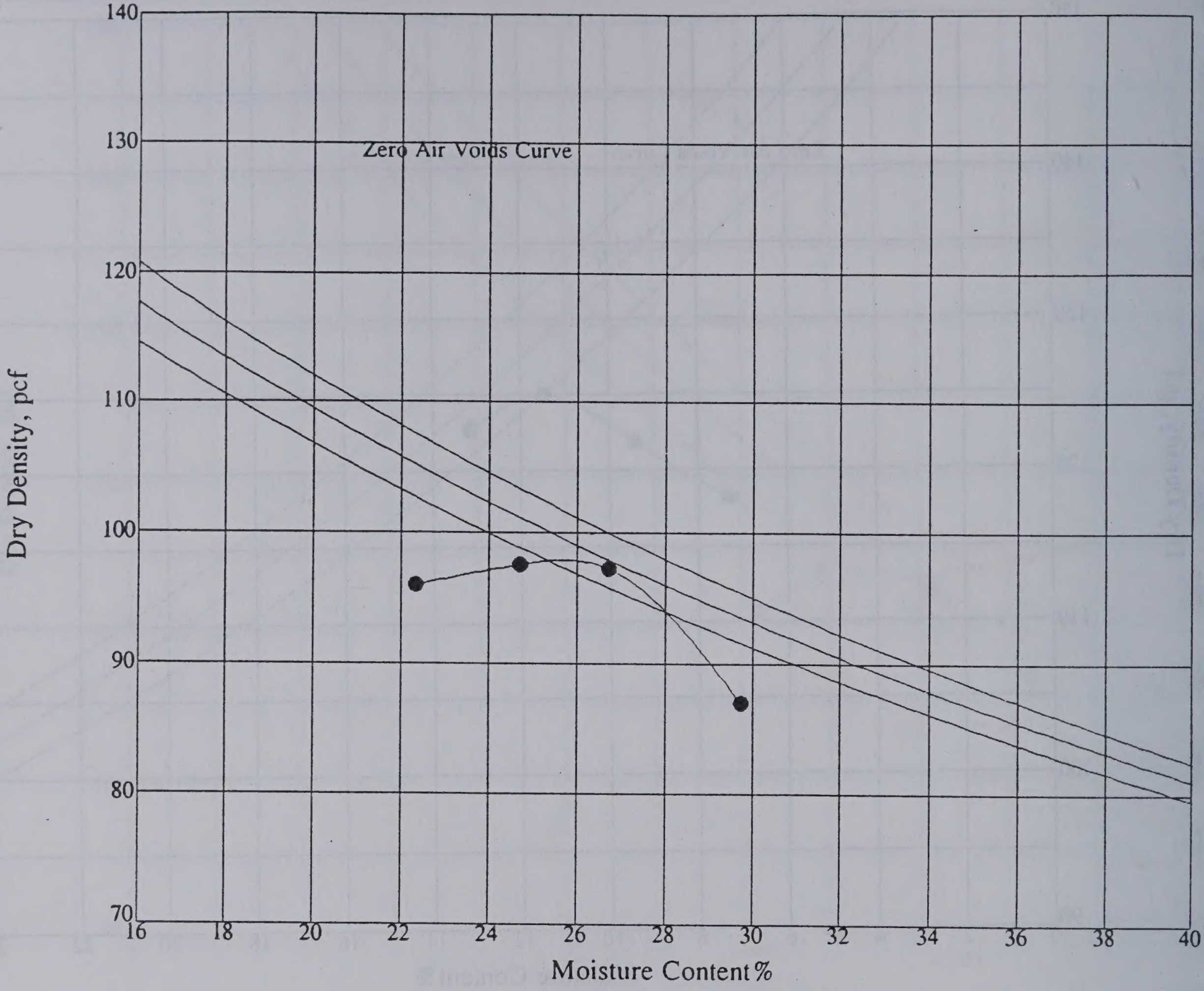
			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 28	Lab: 96310	Depth: Stockpile	125.0	11.5

Soil Description:
POORLY GRADED SAND w/GRAVEL, fine- to coarse-grained, slightly plastic, brown. (SP)
15% aggregate retained on the #4 sieve (cumulative).
8% aggregate retained on the 3/8" sieve (cumulative).
2.7% aggregare retained on the 3/4" sieve (discarded).
Sampled by BOA & PJS/PTS on 07-17-96 on Chamber stockpile.

ASTM D 698-91
Procedure: C

*Density and moisture results rounded to nearest 0.5.

Job No: BJBX-96-057A Appr: JM Date: JUL 18, 1996	Laboratory Compaction Characteristics of Soil (Proctor) LAO/Clark Butte, Montana Braun Intertec Corporation	Plate P-19



Sample No: 29	Lab: 96320	Depth: Lift 2	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
			98.0	25.5

Soil Description: SANDY SILT, fine- to coarse-grained, slightly plastic, brown.
(ML)
5% aggregate retained on the #4 sieve (discarded).
4% aggregate retained on the 3/8" sieve (discarded).
3% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07-09-96 on CTTP5-Lift 2

ASTM D 698-91
Procedure: A

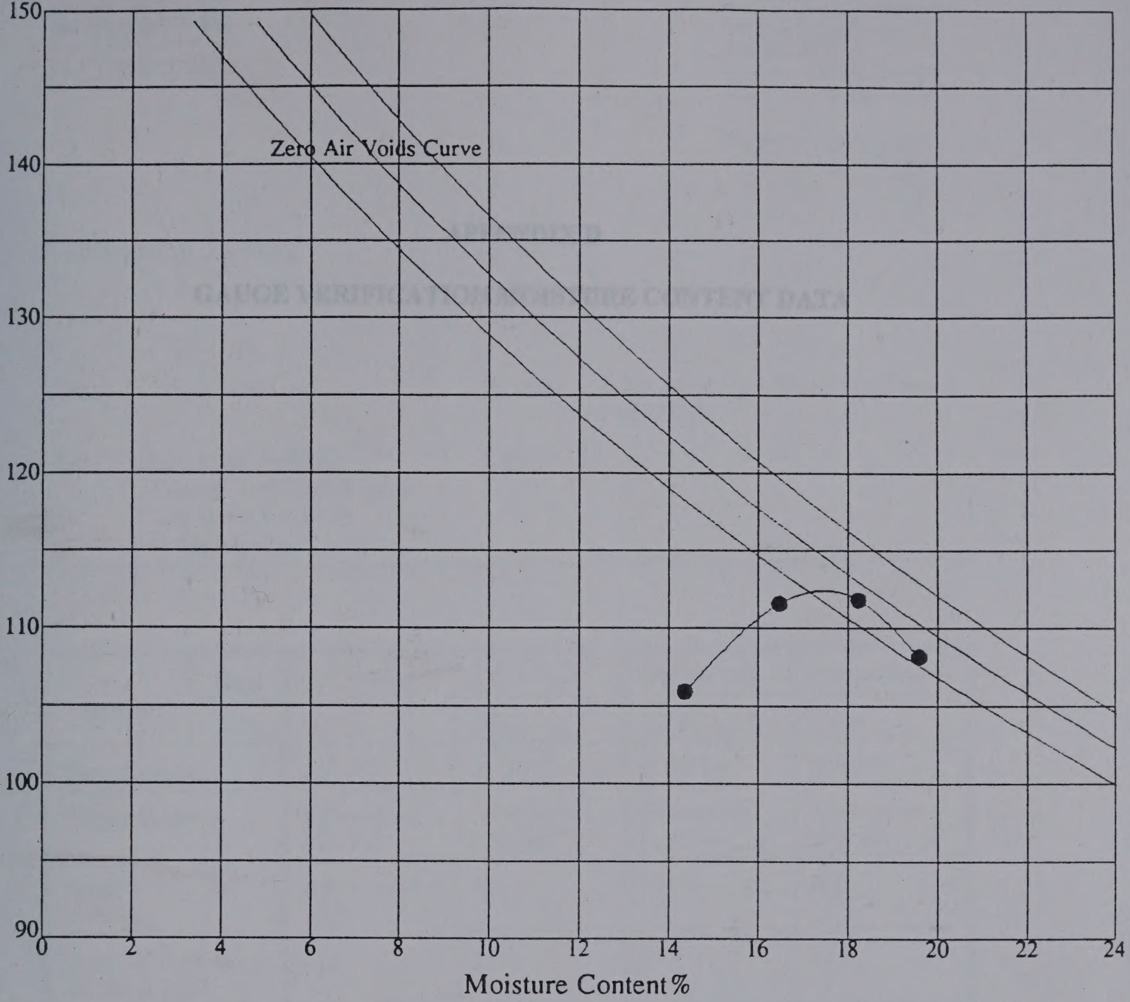
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr: Brad Welch
Date:
JUL 26, 1996

Laboratory Compaction Characteristics of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-20



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
nple No: 30	Lab: 96321	Depth: Lift 1	112.5	17.5

Description: SILTY SAND, fine- to coarse-grained, slighty plastic, brown. (SM).
8% aggregate retained on the #4 sieve (cumulative).
0.4% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07-09-96 on CTTP2-Lift 1

TM D 698-91
cedure: B

*Density and moisture results rounded to nearest 0.5.

No:
X-96-057A
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e:
L 26, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-21

APPENDIX D

GAUGE VERIFICATION MOISTURE CONTENT DATA

BRAUN℠
INTERTEC

Braun Intertec Corporation
1911 Meadowlark Lane
P.O. Box 3026
Butte, Montana 59702-3026
406-494-1675 Fax: 494-1678

Engineers and Scientists Serving the Built and Natural Environments®

Laboratory Testing

Date: July 8, 1996

Project: BJBX-96-057A Laboratory Testing
LAO/Clark

To: Mr. Brad Archibald
Pioneer Technical Services
105 North Excelsior
Butte, Montana 59701

Copies:

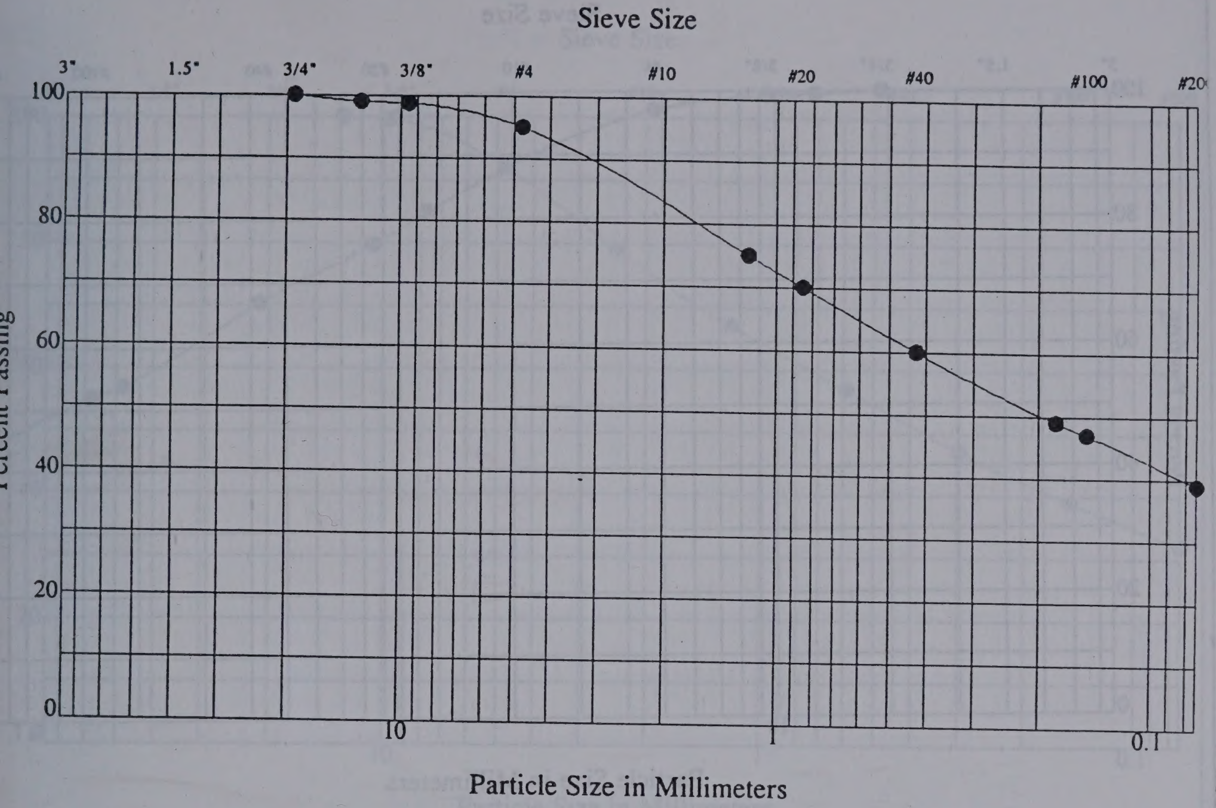
Sample					
Sample	Field	CTTP4-T40	CTTP4-T42	CTTP4-T44	CTTP4-T46
	Lab	96273	96274	96275	96276
Date Sampled		07/03/96	07/03/96	07/03/96	07/03/96
Proposed Use		Informative Analysis	Informative Analysis	Informative Analysis	Informative Analysis
Depth		Not Available (NA)	NA	NA	NA
Moisture content, % ASTM D 2216		14.8	15.0	12.2	12.1

Lowell F. Klocke, CET
Manager, Butte Operations

APPENDIX E

INFILTRATION BARRIER LAYER MATERIALS INDEX PROPERTIES DATA

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	99	95	83	70	60	55	47	38.9

Sample No.: 18 Lab: 96268 Depth: 0' - 6'
Location: CTTP1 - LIFT1
Percent Gravel: 5.0
Percent Sand: 56.1
Percent Silt + Clay: 38.9
Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 30.0
Plastic Limit: 25.8
Plasticity Index: 4.2
Classification: SM
Moisture Content = NT

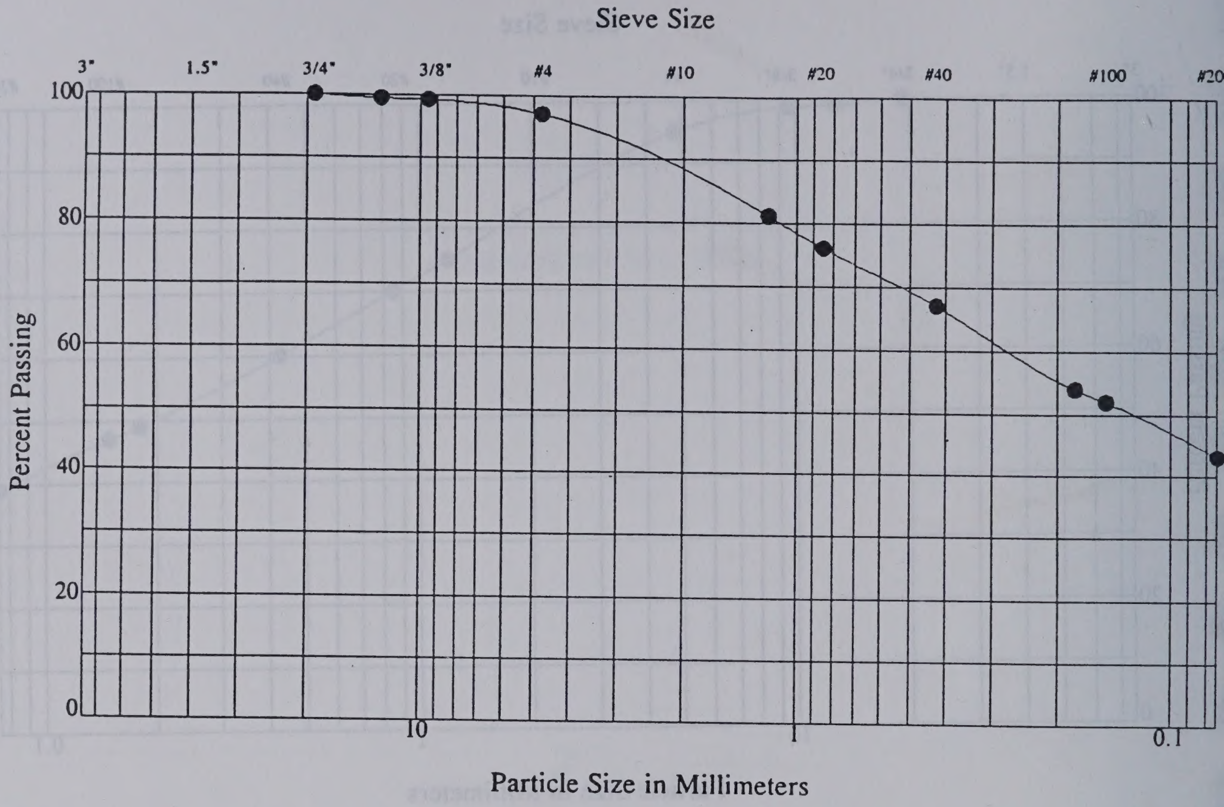
July 9, 1996

LAO/Clark - Butte, Montana

aun Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	99	97	87	76	67	62	52	43.1

Sample No.: 24 Lab No.: 96280 Depth: Lift 2
Location: CTTP1

Percent Gravel: 3.0
Percent Sand: 53.9
Percent Silt + Clay: 43.1

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 36.5

Plastic Limit: 24.3

Plasticity Index: 12.2

Classification: SC

Moisture Content = 22.1

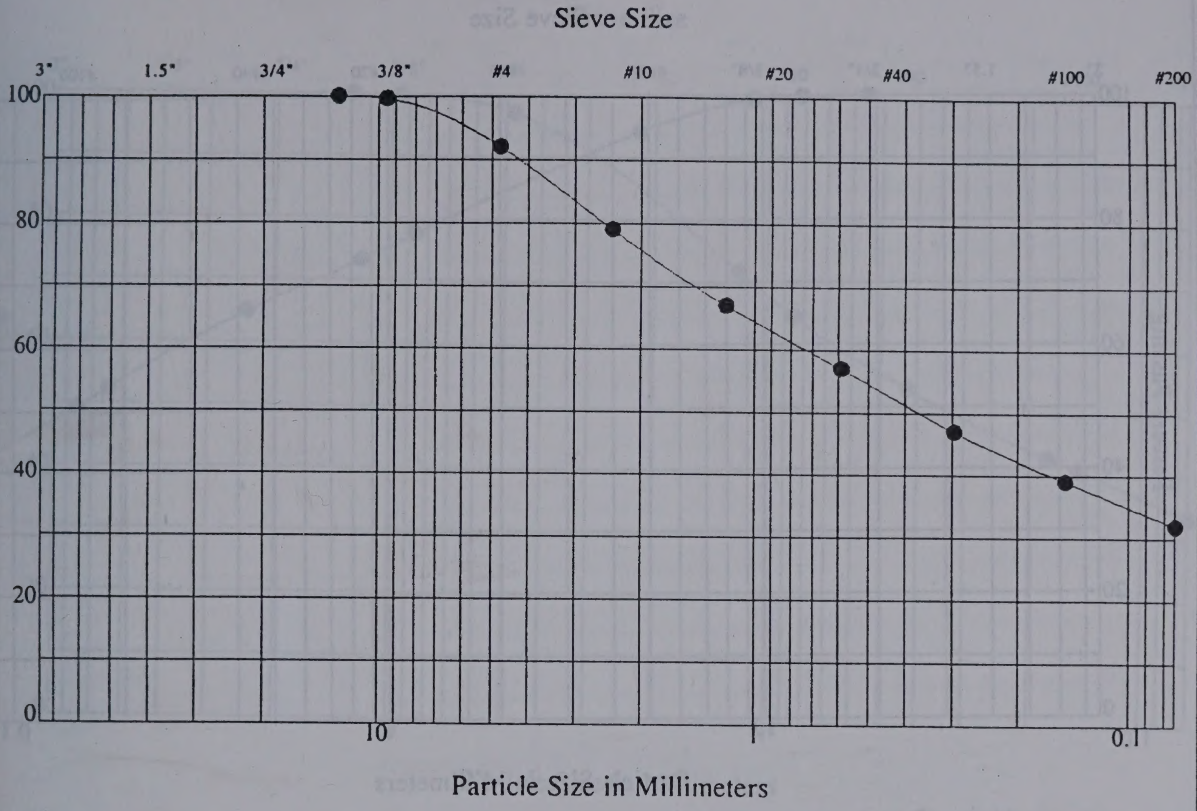
July 12, 1996

LAO/Clark - Butte, Montana

Braun Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	100	92	76	62	52	47	39	31.9

Sample No.: 30 Lab No.: 96321 Depth: Lift 1
Location: CTTP2 50% LAO, 50% HOLLOW DG

Percent Gravel: 8.0
Percent Sand: 60.1
Percent Silt + Clay: 31.9

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 31.0
Plastic Limit: 28.0
Plasticity Index: 3.0
Classification: SM
Moisture Content = NA

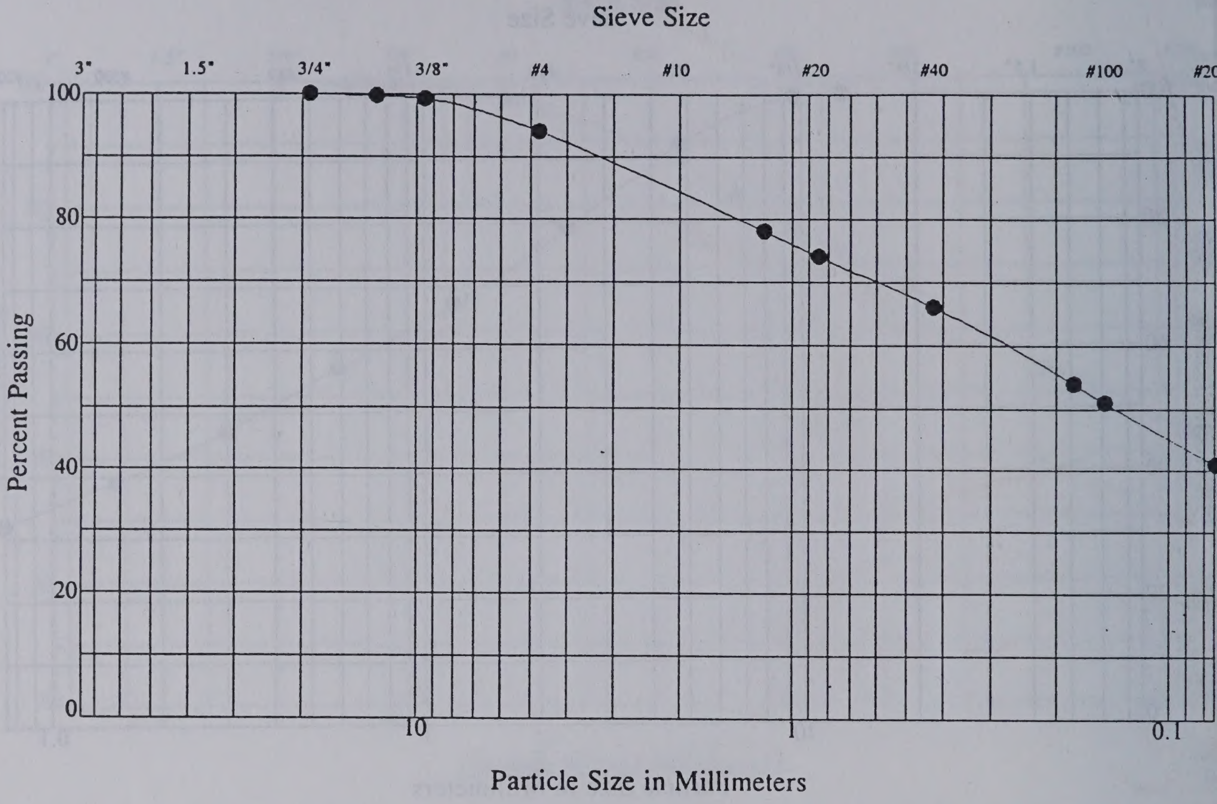
July 26, 1996

LAO/Clark - Butte, Montana

un Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	99	94	84	74	66	61	51	40.9

Sample No.: 19 Lab: 96269 Depth: 0' - 6'
Location: CTTP2 - 75% LAO
25% DG
Percent Gravel: 6.0
Percent Sand: 53.1
Percent Silt + Clay: 40.9
Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit:	33.8
Plastic Limit:	27.6
Plasticity Index:	6.2
Classification:	SM
Moisture Content = NT	

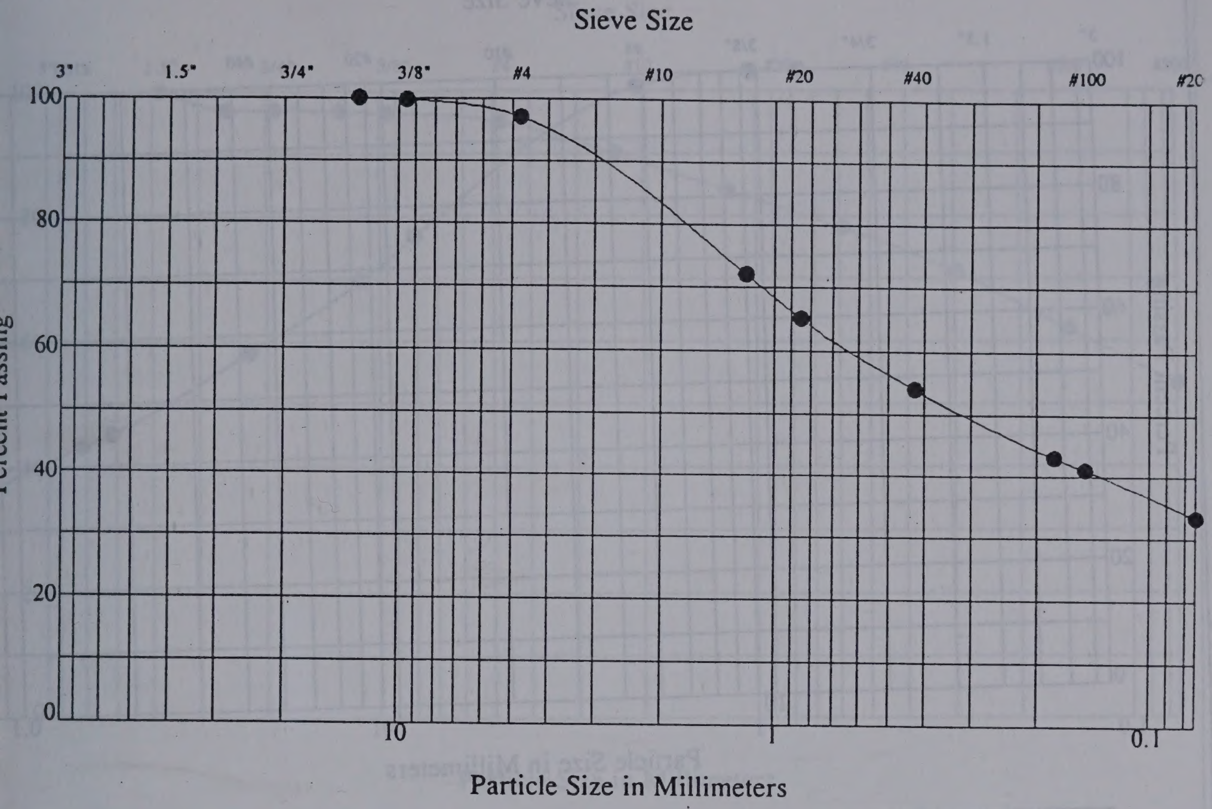
July 9, 1996

LAO/Clark - Butte, Montana

Braun Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	100	97	81	65	54	49	41	33.3

Sample No.: 26 Lab No.: 96282 Depth: Lift 2
Location: CTTP4

Percent Gravel:	3.0
Percent Sand:	63.7
Percent Silt + Clay:	33.3

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 28.6

Plastic Limit: 21.3

Plasticity Index: 7.2

Classification: SC

Moisture Content = 13.1

July 12, 1996

LAO/Clark - Butte, Montana

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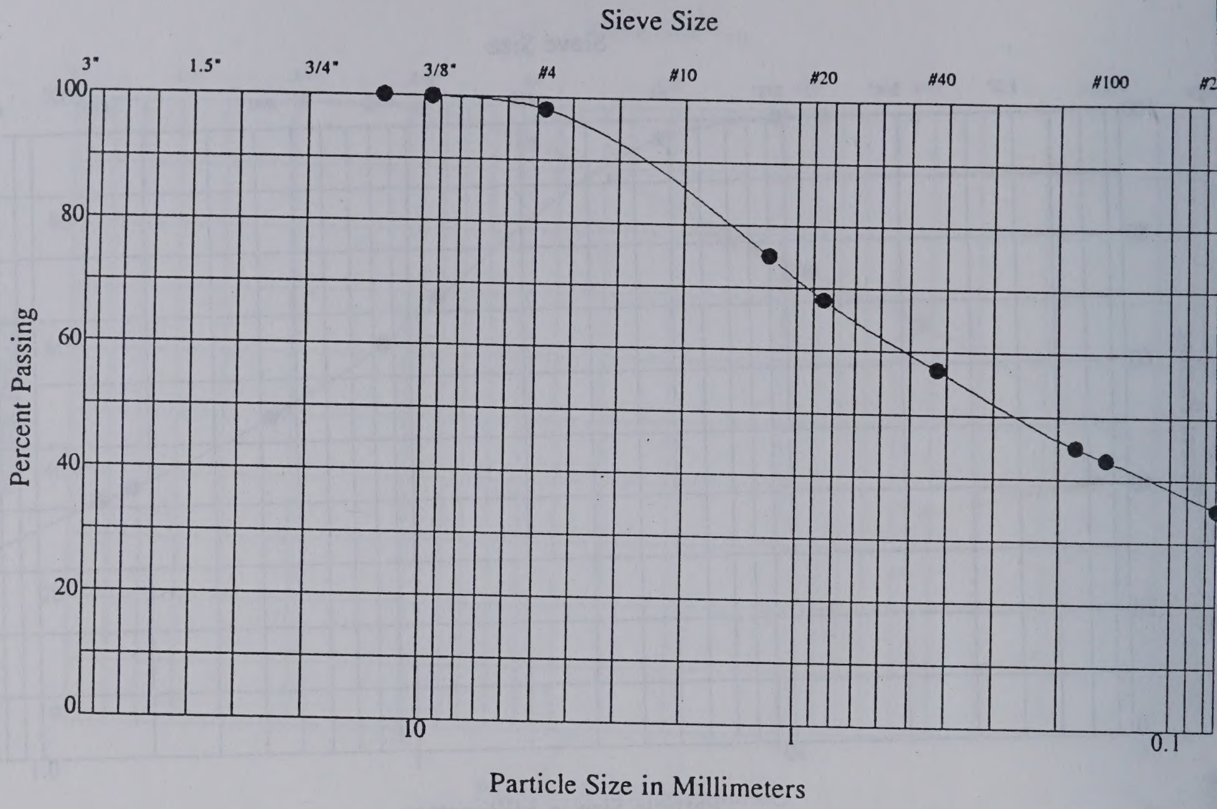
Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	100	98	84	68	57	52	43	35.1

Sample No.: 25 Lab No.: 96281 Depth: ~~Lift 2~~ LIFT 3
Location: CTTP4

Percent Gravel: 2.0
Percent Sand: 62.9
Percent Silt + Clay: 35.1

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 28.0

Plastic Limit: 21.1

Plasticity Index: 6.9

Classification: SC-SM

Moisture Content = 13.2

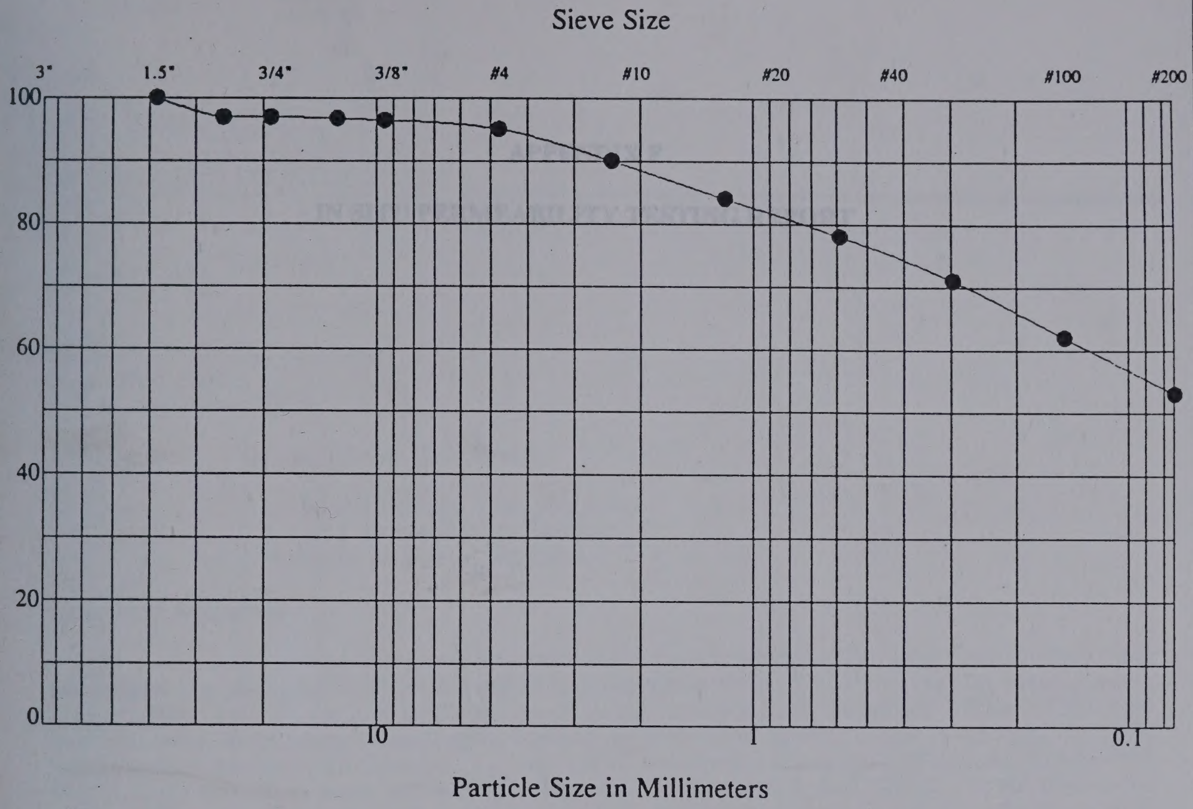
July 12, 1996

LAO/Clark - Butte, Montana

Braun Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	97	96	95	88	81	75	71	62	53.0

Sample No.: 29 Lab No.: 96320 Depth: Lift 2
Location: CTTP5

Percent Gravel: 5.0
Percent Sand: 42.0
Percent Silt + Clay: 53.0

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 34.0

Plastic Limit: 30.6

Plasticity Index: 3.4

Classification: ML

Moisture Content = NA

July 26, 1996

LAO/Clark - Butte, Montana

un Intertec Corporation

Project No.: BJBX-96-057A

APPENDIX F

IN SITU PERMEABILITY TESTING REPORT

NTL
ENGINEERING &
GEOSCIENCE, INC.
1505 14th ST. S.W. • P.O. Box 3269 • Great Falls, MT 59403-3269 • (406) 453-5400

July 31, 1996

Pioneer Technical Services
P.O. Box 3445
Butte, Montana 59702

Attention: Mr. Brad Archibald

Subject: Clark Tailings Disposal Area
Field Permeability Testing
South of Butte, Montana

Dear Mr. Archibald:

At your request, we have performed one dimensional field vertical permeability testing of the test pad barrier layers at the referenced project. The testing attempted to include five tests on each of four test pads using different soil materials. Some of the test locations would not permit meaningful testing as evidenced by rapid discharging of the field permeability devices. On Pad No. 1, only three tests were actually performed; and on Pad No. 2, only two tests were actually performed. On Pad No. 4 and Pad No. 5, all five tests were performed. The vertical field permeability testing was conducted in accordance with methods described by Gordon P. Boutwell, Ph.D., P.E., in the technical paper "The STEI Two-Stage Borehole Field Permeability Test" presented at the Containment Liner Technology and Subtitle D Seminar on March 12, 1992, in Houston, Texas.

The test pads were constructed under your supervision prior to our arrival on-site. The devices were installed by hand excavation methods. Total test pad thickness was assumed to be the planned 18 inches. The field permeability test results are summarized on the following page, along with sand cone field density test results for Pad No. 1 and Pad No. 4.

The field permeability tests indicate comfortable compliance with the specification requirement for a coefficient of permeability of 1x10^{-5} cm/sec or less. Please call if you have questions.

Sincerely,

Kenneth D. Munski, P.E.
Sr. Materials Engineer

Gary A. Quinn, P.E.
Sr. Geotechnical Engineer

KDM/GAQ/tp

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 1

Pad No.-Test No. Identification	Test Location	Casing Embedment (In.)	Total Pad Depth (In.)	Field Vertical Permeability, k_v (cm/sec)*	Field Dry Density (lb/ft^3)**	Field Moisture Content, (%)**
1-1	6' S. & 16' W. NE Pad Corner	10	18	N/A***	98.8	23.9
1-2	4' S. & 11' E. of NW Pad Corner	10	18	$3.9x10^{-7}$	---	---
1-3	7' N. & 6' E. of SW Pad Corner	10	18	$2.7x10^{-7}$	---	---
1-4	5' N. & 24' W. of SE Pad Corner	10	18	$7.2x10^{-7}$	---	---
1-5	14' S. & 3' W. of NE Pad Corner	10	18	N/A***	103.2	20.8

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.
**Sand cone field density result.
***Test could not be performed due to rapid discharge of field permeameter.

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 2

Pad No.-Test No. Identification	Test Location	Casing Embedment (In.)	Total Pad Depth (In.)	Field Vertical Permeability, k_v (cm/sec)*
2-1	5' S. & 5' E. of NW Pad Corner	10	18	N/A***
2-2	11' S. & 10' E. of NW Pad Corner	10	18	$2.6x10^{-7}$
2-3	10' S. & 18' E. of NW Pad Corner	10	18	$1.0x10^{-6}$****
2-4	6' S. & 22' E. of NW Pad Corner	10	18	N/A***
2-5	10' S. & 28' E. of NW Pad Corner	10	18	N/A***

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.

***Test could not be performed due to rapid discharge of field permeameter.

****Limited test time (3 hr) before rapid discharge terminated the test.

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 4

(Note to reviewer: Pad No. 3 was dropped, not tested.)

Pad No.-Test No. Identification	Test Location	Casing Embedment (In.)	Total Pad Depth (In.)	Field Vertical Permeability, k_v (cm/sec)*	Field Dry Density (lb/ft^3)**	Field Moisture Content, (%)**
4-1	7' S. & 14' E. of NW Pad Corner	10	18	1.6×10^{-7}	---	---
4-2	6' S. & 6' E. of NW Pad Corner	10	18	1.4×10^{-7}	128.0	11.0
4-3	4' N. & 19' W. of SE Pad Corner	10	18	1.6×10^{-7}	---	---
4-4	3' S. & 6' W. of NE Pad Corner	10	18	5.2×10^{-7}	---	---
4-5	4' W. & 6' W. of SE Pad Corner	10	18	4.3×10^{-7}	118.3	11.3

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.
**Sand cone field density result.

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 5

Pad No.-Test No. Identification	Casing Test Location	Total Embedment (In.)	Field Vertical Pad Depth (In.)	Permeability, k_v (cm/sec)*
5-1	6' S. & 8' E. of NW Pad Corner	10	18	6.8×10^{-7}
5-2	9' S. & 15' E. of NW Pad Corner	10	18	1.3×10^{-7}
5-3	6' S. & 18' E. of NW Pad Corner	10	18	1.5×10^{-7}
5-4	11' S. & 22' E. of NW Pad Corner	10	18	4.2×10^{-7}
5-5	6' S. & 27' E. of NW Pad Corner	10	18	1.4×10^{-7}

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.

FIELD PERMEABILITY STATISTICS
Clark Tailings Disposal Area

Pad 1 Statistics

	Well 2	Well 3	Well 4
Mean	3.92E-07	2.72E-07	7.97E-07
Standard Error	5.52E-08	1.28E-08	1.99E-07
Median	3.12E-07	2.68E-07	4.47E-07
Standard Deviation	2.21E-07	5.13E-08	7.97E-07
Variance	4.88E-14	2.63E-15	6.35E-13
Skewness	2.545943	0.299697	2.620354
Range	8.61E-07	1.81E-07	3.09E-06
Minimum	2.41E-07	1.95E-07	3.61E-07
Maximum	1.1E-06	3.77E-07	3.09E-06
Sum	6.27E-06	4.35E-06	9.57E-06
Count	16	16	12

Pad 2 Statistics

	Well 2	Well 3
Mean	2.56E-07	1E-06
Standard Error	1.66E-08	4.62E-08
Median	2.33E-07	1E-06
Standard Deviation	5.98E-08	1.66E-07
Variance	3.58E-15	2.77E-14
Skewness	-0.57008	2.253732
Range	3.52E-07	1.12E-06
Minimum	1.44E-07	8.84E-07
Maximum	3.52E-07	1.12E-06
Sum	2.56E-06	2E-06
Count	10	2

Pad 4 Statistics

	Well 1	Well 2	Well 3	Well 4	Well 5
Mean	1.61E-07	1.36E-07	1.63E-07	5.24E-07	4.25E-07
Standard Error	1.12E-08	7.23E-09	7.85E-09	3.04E-08	1.42E-08
Median	1.36E-07	1.28E-07	1.51E-07	5.4E-07	4.31E-07
Standard Deviation	4.17E-08	2.7E-08	2.94E-08	9.63E-08	5.31E-08
Variance	1.74E-15	7.31E-16	8.63E-16	9.27E-15	2.82E-15
Skewness	0.683664	1.291359	1.121636	-0.41799	-2.7289
Range	1.09E-07	1.04E-07	1.07E-07	3.11E-07	4.97E-07
Minimum	1.16E-07	1.01E-07	1.24E-07	3.51E-07	3.31E-07
Maximum	2.25E-07	2.05E-07	2.31E-07	6.63E-07	4.97E-07
Sum	2.25E-06	1.91E-06	2.28E-06	5.24E-06	5.53E-06
Count	14	14	14	10	13

Pad 5 Statistics

	Well 1	Well 2	Well 3	Well 4	Well 5
Mean	6.78E-07	1.29E-07	1.52E-07	4.18E-07	1.37E-07
Standard Error	4.03E-08	1.64E-08	6.08E-09	1.78E-08	3.02E-09
Median	6.31E-07	1.19E-07	1.37E-07	3.98E-07	1.4E-07
Standard Deviation	1.45E-07	5.91E-08	2.28E-08	6.43E-08	1.09E-08
Variance	2.12E-14	3.49E-15	5.18E-16	4.14E-15	1.19E-16
Skewness	-1.2467	3.441922	-0.46833	0.222949	0.057463
Range	8.63E-07	2.29E-07	2.01E-07	1.9E-07	3.13E-08
Minimum	4.82E-07	9.45E-08	1.31E-07	3.33E-07	1.21E-07
Maximum	8.63E-07	3.24E-07	2.01E-07	5.23E-07	1.53E-07
Sum	7.45E-06	1.68E-06	1.37E-06	5.43E-06	1.78E-06
Count	11	13	9	13	13

APPENDIX G

LABORATORY PERMEABILITY TESTING DATA

Project: BJBX-95-066A
LAO Segment II
Phase I
Butte, Montana

Date: 14-May-96

Sample: TP-1, Peat/Clay

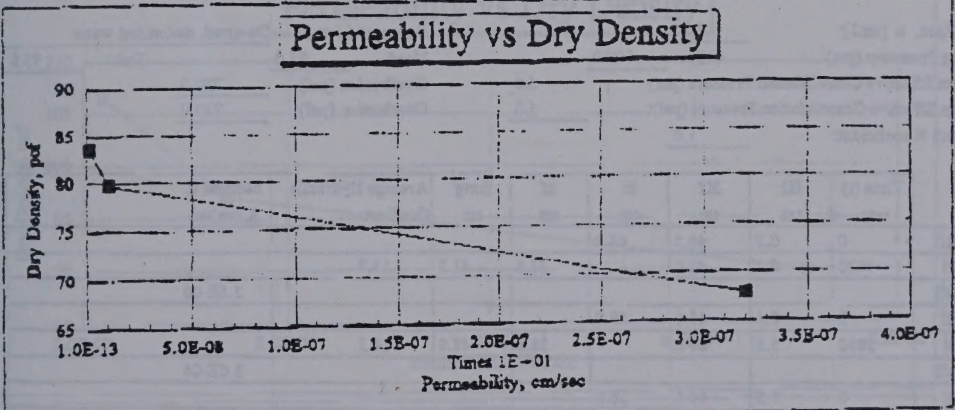
Lab Number 53, 96113

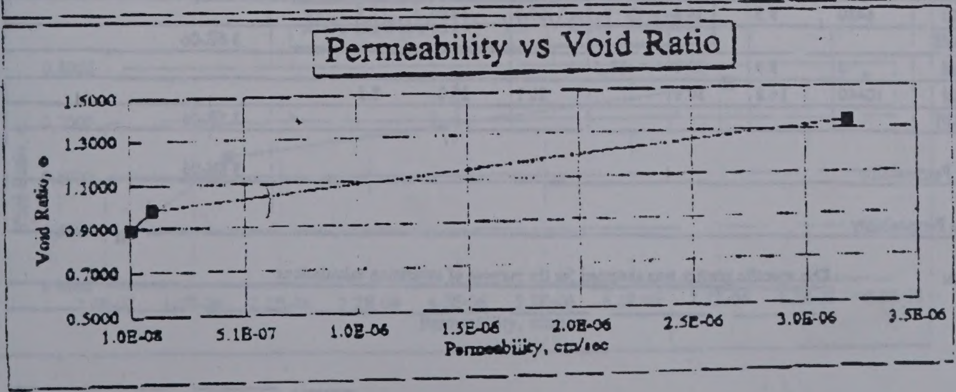
Description: Silty Sand, high plasticity, fine to coarse sand, dark brown to black, moist.

Specific Gravity 2.536

Staged Permeability Test Data

Stage	Overburden (psi)	Permeability (cm/sec)	Dry Density (pcf)	Void Ratio	Relative Compaction (%)
1	2	3.2E-06	67.8	1.3349	91.0%
2	22	1.1E-07	79.7	0.9849	107.0%
3	72	1.3E-08	83.6	0.8921	112.2%





Permeability Test

ASTM D 5084 (Method C: Falling Head, Rising Tailwater)

Project: BJBX-95-066A
LAO Segment II
Phase I
Butte, Montana

Date: 04/16/96

LAVELLE / HOLLOW PIT

Field No.: 51 **Sample:** 96104 **Depth:** - **Location:** BSB WWTF Stk Pile

Sample Description: Clayey Sand, fine to coarse grained, low plasticity, light brown, moist.
Remolded

Initial		Final	
Wt. Specimen + Tare Wet:	669.60	Wt. Specimen + Tare Wet:	
Wt. Specimen + Tare Dry:	626.00	Wt. Specimen + Tare Dry:	
Wt. Tare:	120.70	Wt. Tare:	
Moisture Content:	8.6%	Moisture Content:	ERR

Initial Diameter (in):	2.9	Initial Area, A (in2):	6.47	Initial Wt. (gm):	655.10
Initial Ht. (in):	3.0	Initial Dry Unit Wt. (pcf):	117.6	Initial Saturation:	ERR
Final Ht., L (in):	3.0	Final Area, A (in2):	6.47		
Final Diameter (in):	2.9	Final Dry Unit Wt. (pcf):		Final Saturation:	ERR
Sp. Gravity:					

Burette Area, a (cm2): 1.00
Operating Pressures (psi): Cell: 100.0
Maximum Effective Consolidation Pressure (psi): 5.0
Minimum Effective Consolidation Pressure (psi): 5.0
Skempton's B coeficient: 1.0

Permeant Liquid: De-aired, de-ionized water
Head: 95.0 Tail: 95.0
Overburden (psf): 720.0
Overburden (psf): 720.0

	Time (t) sec	H1 cm	H2 cm	hi cm	hf cm	havg cm	Average Hydraulic Gradient	Method C K cm/sec
Initial	0	0.7	49.5	48.8				
Final	9420	8.2	42.0		33.8	41.3	13.7	
Result								3.6E-06
Initial	0	0.4	49.4	49.0				
Final	5880	5.5	44.3		38.8	43.9	14.5	
Result								3.6E-06
Initial	0	5.5	44.1	38.5				
Final	6480	9.9	39.8		29.9	34.3	11.3	
Result								3.6E-06
Initial	0	9.9	39.8	30.0				
Final	10440	14.8	34.9		20.1	25.0	8.3	
Result								3.5E-06
Average Permeability								3.6E-06
Assigned Permeability								

Remarks: The specific gravity was assumed for the purpose of saturation calculations.

Materials Engineer

Project: BJBX-95-066A
LAO Segment II
Phase I
Butte, Montana

Date: 16-Apr-96

Sample: TP-3, Mix Peat Clay

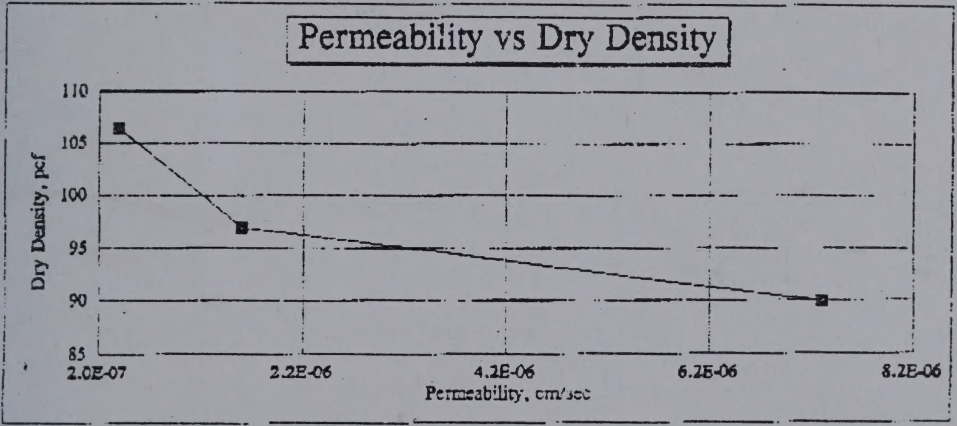
Lab Number 54, 96114

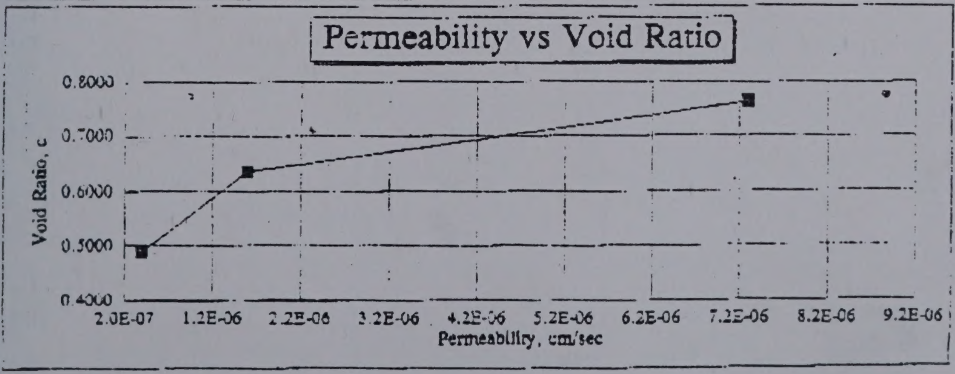
Description: Silty Sand, fine to coarse grained, nonplastic, dark brown, moist.

Specific Gravity 2.541

Staged Permeability Test Data

Stage	Overburden (psi)	Permeability (cm/sec)	Dry Density (pcf)	Void Ratio	Relative Compaction (%)
1	2	7.3E-06	89.9	0.7628	89.5%
2	22	1.6E-06	97.0	0.6353	96.5%
3	67	3.9E-07	106.5	0.4891	106.0%


Permeability vs Dry Density


Permeability vs Void Ratio

Silver Bow Co.
Old Butte #20
Closure

Draft

PHASE 1, SEGMENT II EXPEDITED RESPONSE ACTION LOWER AREA ONE OPERABLE UNIT WORK PLAN/FINAL DESIGN REPORT

Addendum 1
Clark Tailings Alternate Repository

For
Lower Area One Operable Unit
Silver Bow Creek/Butte Area (Original Portion)
Superfund Site

Prepared for and by:
Atlantic Richfield Company
307 E. Park, Suite 400
Anaconda, Montana

January 30, 1997

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1.0 INTRODUCTION

The purpose of this Addendum is to describe the regulatory framework, planning, schedule, design work, and physical implementation required for placing excavated materials from Lower Area One (LAO) at the Clark Tailings site. Clark Tailings is being proposed as an alternate disposal location to the Opportunity Ponds. The possibility of an alternate disposal location was described in the Phase I, Segment II LAO Expedited Response Action Work Plan/Design Report (LAO WP/DR). The implementation of this Addendum is subject to change pending field conditions and agency field approval.

EPA and the Montana Department of Environmental Quality/Solid Waste Program (MDEQ/SWP) are the regulatory bodies governing placement of LAO materials at Clark Tailings. The excavation and transport of the LAO materials remain under the authority of EPA in accordance with CERCLA and applicable and relevant and appropriate requirements (ARARs) previously identified for the project. This Addendum describes only the transportation route and activities between the LAO and Clark Tailings sites. Closure of the Clark Tailings site is under the jurisdiction of MDEQ/SWP and applicable Resource Conservation and Recovery Act (RCRA), Montana Solid Waste Management Act (MSWMA), and applicable Montana solid waste regulations at Title 17, Chapter 50 of the Administrative Rules of Montana (ARM). Details regarding closure and long-term monitoring of the Clark Tailings site are not included in this Addendum, but may be found in the "Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment" and associated design documents.

If the proposal to haul and place LAO materials at the Clark Tailings is approved, ARCO plans to complete the LAO removal action and capping at Clark Tailings no later than mid-summer 1998, but perhaps as early as late-1997 depending on weather, date of approval to proceed, and other factors.

2.0 BACKGROUND

Original discussions regarding the use of the Clark Tailings as a possible site for disposal of LAO wastes occurred over four years ago. ARCO and the agencies began discussing again the possibility of an alternative location to place materials excavated from the LAO as part of the Phase I, Segment II Expedited Response Action in late 1995. On-going discussions and development of information to support the use of the Clark Tailings site as an alternative location have occurred since early 1996.

The Clark Tailings disposal location is being proposed as an alternative to the Opportunity Ponds. No further disposal of LAO materials at Opportunity Ponds will occur if Clark Tailings is approved.

3.0 OBJECTIVES

The regulatory requirements in selecting an alternative location include:

- choose a location and design that meets RCRA, MSWMA, and applicable ARM 17.50 regulations; and
- be at least as protective of human health and the environment as the Opportunity Ponds location.

In addition to satisfying the regulatory requirements, other objectives in selecting an alternative location include:

- allow for quicker completion of the LAO expedited response action, thus allowing for better sequencing of other projects including Butte Priority Soils and Streamside Tailings;
- complete closure or remedial actions at LAO, Clark Tailings and the Old Butte-Silver Bow Landfill concurrently;
- provide for cost-effective excavation and disposal of materials from LAO; and
- provide re-development opportunities for the local community.

Placement of the LAO materials at the Clark Tailings will meet the aforementioned regulatory requirements and objectives. Closure under solid waste regulations will ensure that the plan is protective of human health and the environment and complies with applicable solid waste regulations. The haul to the Clark Tailings is approximately 25 miles shorter than to Opportunity and, therefore, less prone to accidents. Primarily because of the shorter haul and the higher rate of haul afforded by off-road trucks, placement at the Clark Tailings will allow for a substantially quicker completion of the LAO Phase I, Segment II Expedited Response Action. The quicker schedule also equates to less short-term risk to human health and the environment. Furthermore, the quicker schedule will allow for better sequencing at other sites, including Butte Priority Soils and Streamside Tailings and quicker re-development of the LAO and Clark Tailings sites. The placement of the LAO materials at the Clark Tailings will benefit the community by providing re-development of the site as a recreational facility. Finally, the Clark Tailings option will be less costly to implement than the Opportunity Ponds option.

4.0 CLARK TAILINGS DISPOSAL SITE

The Clark Tailings, along with the adjacent Old Silver Bow County Landfill, is in the process of being closed in accordance with applicable solid waste regulations at ARM 17.50. The closure of the Clark Tailings under RCRA and MSWMA has been agreed to by the EPA and MDEQ (Wardell to Lynch, 3/1/95, and Robinson to Lynch, 3/23/95).

Expected end-land use at Clark Tailings is a public recreational complex. The "Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment" and associated design documents include further details about the repository to be located at Clark Tailings.

5.0 LAO MATERIALS TRANSPORTATION PLAN

This section describes routing, design, construction activities and maintenance of the haul road for transporting excavated materials from LAO to the Clark Tailings. Attachment II includes a plan view of the haul route, haul road design details, and a written work plan describing material transport. Alternative haul routes and designs may be used if approved by the agencies prior to implementation, but are not anticipated at this time. The use of the Clark Tailings will not alter the excavation and reclamation of the LAO site from the action described in the LAO Phase I, Segment II Expedited Response Action Work Plan.

5.1 HAUL ROUTE AND EQUIPMENT

The haul between LAO and Clark Tailings will generally be a two-lane, one road haul. Starting from LAO and moving south, the proposed road crosses the Montana Western railroad track, transects the MPTP site, crosses Greenwood Avenue, traverses the old rail grade between Greenwood Avenue and Beeftrail Road, and crosses Beeftrail Road to the Clark Tailings site. The only interaction between the public and the haul will be the crossings at Greenwood Avenue and Beeftrail Road.

Rigid frame, 35-50 Ton haul trucks will leave LAO loaded to Clark Tailings and return either empty or loaded with clean backfill for LAO. Continuous hauling will occur up to 10 hours per day, 6 days per week. A night shift haul may also be introduced.

5.2 DESIGN, CONSTRUCTION, AND HAUL GUIDELINES

Detailed haul road design drawings and a work plan are included in Attachment II. Haul road design, construction and hauling guidelines will generally include the following.

- Two way haul roads will be built to a 50-foot travel width and a 25-foot travel width for one-way roads (curves may require a larger travel width).
- Elevated haul roads will be constructed with a safety berm to a minimum of truck axle height.
- Haul traffic speed will be limited to 35 miles per hour on straight, off-road

stretches.

- Haul traffic speed will be reduced to 30 miles per hour or less across railroad tracks and public roads and through the Montana Pole and Treating Plant (MPTP) site.
- Haul traffic speed around curves will be designated appropriately for the curve radius.
- Haul road grades will be limited to no more than 12% unless otherwise approved.
- Materials placed as fill to construct the haul road will be graded or removed and transported to the Clark Tailings or another approved location during removal/reclamation of the haul roads.
- Haul road design will not adversely impact existing drainage patterns, sedimentation ponds, or other constructed features at MPTP or other locations.
- Culverts will be installed or extended as needed to maintain adequate drainage throughout the transportation route.
- Silt fence, straw bales, or the equivalent will be installed and maintained where required to prevent siltation of active streams (i.e., Silver Bow Creek).
- One or more crossings will be constructed across Silver Bow Creek as needed for hauling tailings and fill materials. The crossing will be constructed similar to that shown on Detail 2-2, Sheet 2-9 of the LAO construction drawings (see copy in Attachment II).
- One at-grade rail crossing--constructed of rail ties and pre-cast concrete--will be installed on the Montana Western Railroad, near the northeast corner of the MPTP site. Safe crossing policies and procedures will be determined jointly by Montana Western and ARCO and its Contractor.
- It is anticipated that some noise will be generated during working hours; however, the nearest residential area is approximately 1,000 feet from the haul road, and no more noise than is currently generated by the nearby interstate or the MPTP site activities is anticipated.
- Road crossing and public safety issues are addressed in Section 6.0 of this document.

- Where the haul road crosses under the I-90 overpass, interstate piers will be protected with earthen berms, Jersey concrete barriers, or both. Field surveys have been completed to show that there is sufficient space for the haul road between the I-90 bridge piers.

- Adequate vertical clearance to the bottom of the I-90 bridge girders will be maintained.

5.3 MONTANA POLE AND TREATING PLANT SITE CONSIDERATIONS

The proposed haul route to Clark Tailings transects the MPTP site as shown on the map in Attachment II. ARCO and its Contractor will continue to work cooperatively with the State and its Contractor to address unforeseen issues. Issues addressed thus far are described in the documents found in Attachments I and II. A summary of these issues follows below.

5.3.1 Elevated Rail Grade (Newcome Branch)

The Newcome Branch is an abandoned railroad embankment which lies on the eastern border of the MPTP site. A substantial portion of the Newcome Branch embankment will be removed to construct a safe and adequate haul road from LAO to the Clark Tailings. Details regarding haul road construction on the elevated grade are found in Attachment II and summarized below.

- The elevated grade will be cut down approximately 7 to 12 feet to accommodate two-way traffic with safety berms.

- Material excavated from the grade will be hauled to the Clark Tailings for disposal. Some cut material will be used as fill for temporary ramps and haul road depressions within the MPTP site, then later hauled to Clark Tailings. Material used as temporary fill will be separated from existing MPTP soils by a thin layer of imported clean fill overlaid with geotextile or equivalent to maintain physical separation between original grade and temporary fill.

- The chain-link security fence that currently exists on top of the railroad grade will be removed and relocated (by ARCO) to the eastern toe of the railroad grade to accommodate the haul road. The fence will be placed no closer than 12.5' to the centerline of the adjacent railroad line, but far enough from the toe of the grade to accommodate future construction activities. The fence will remain in its new location after completion of LAO hauling activities.

- The power poles and air monitoring stations currently located on the grade will be

relocated (by ARCO) to locations approved by MPTP project representatives.

5.3.2 Additional MPTP Issues

Additional issues with respect to the LAO haul road transecting the MPTP site are listed below.

- Current MPTP remedial activities will retain access priority through the MPTP site. Coordination efforts between LAO and MPTP projects will continue to avoid schedule or operational impacts to either project.

- The function and integrity of MPTP site drainage facilities, specifically those south and north of Greenwood Avenue and immediately south of the Newcome Branch grade, will be maintained.

- For security purposes, haul road access gates will be installed in the fences on the north and south ends of the MPTP site. These gates will be closed and locked during off hours. Gates and other possible entrances to the haul road will be monitored by haul truck drivers, construction foremen, or flaggers.

- The architectural firm leasing the green building adjacent to Greenwood Avenue will be permanently relocated. ARCO will demolish the building and adjacent sump.

- The on-site resident at MPTP (Oaas) will either be relocated or safety precautions will be discussed between ARCO and the resident and implemented as necessary.

5.4 HAUL ROAD MAINTENANCE

The haul roads will be maintained on a frequent basis to minimize dust from haul traffic, collect spilled or tracked tailings, and maintain the quality of the road. General haul road maintenance items include the following.

- Haul roads and berms will be graded with a motor patrol, or equivalent.

- Water trucks and/or chemical applications (e.g., magnesium chloride) will be used to control dust.

- Spilled or tracked tailings on the haul roads (excluding public crossings) will be collected on an as-needed basis and disposed at the Clark Tailings.

- Infrequent spilled or tracked LAO materials at public road crossings will be

removed promptly to prevent public vehicles from tracking spilled material.

6.0 HEALTH AND SAFETY ISSUES

6.1 GENERAL HEALTH AND SAFETY

Hauling activities between LAO and the Clark Tailings will conform to all federal, state, and local rules and regulations. Contractor truck drivers, equipment operators, and supervisory personnel will be trained and capable of performing their duties in a safe manner. Construction equipment inspections and maintenance will be performed on a regular basis.

ARCO and its Contractor will maintain frequent communications with public officials, MPTP representatives and contractors, and affected landowners to ensure that proper safety measures are implemented.

6.2 TRAFFIC CONTROL/PUBLIC SAFETY

As described in Section 5.1 above, interaction between the proposed haul and the public is limited to two intersections--one at Greenwood Ave. (near the MPTP site) and one at Beeftrail Road (near Clark Tailings). The public road crossings at Greenwood Avenue and Beef Trail Road will be signed and flagged as per the Uniform Traffic Control Manual. Haulage across the two intersections will be continuously monitored and controlled by flaggers. Public traffic will be prohibited from haul roads by flagmen during regular shifts and by gates during non-working hours.

Approximately one haul truck every 90 seconds will be crossing public roads. Haul trucks will be given the right-of-way by flaggers. Public traffic will be safely signaled through the crossing as haul traffic dictates.

6.3 DECONTAMINATION OF EQUIPMENT

Equipment which is used at LAO or the Clark Tailings and contains visible tailings will be decontaminated prior to leaving the site onto publicly traveled roads or other jobs. No decontamination of equipment will be completed for travel between LAO and Clark Tailings on the primary haul road, or between LAO and other haul areas accessed by off-road haul equipment. For off-road haul and public road crossings associated with off-road haul, roads will be controlled, maintained and cleaned as discussed in Sections 5.3 and 6.2.

Where equipment decontamination is required, decontamination procedures will include, at a minimum, the following:

- Contact water from equipment decontamination will be captured and contained on the site.

- Sediment from the decontamination facilities will be routinely disposed at the Clark Tailings after drying.

- Equipment that requires wet washing will be completed within LAO or Clark Tailings, with contact water captured and managed in a manner to prevent infiltration into the Clark Tailings fill;

- Equipment, if dry, will be brushed clean using approved procedures;

- Wet washing will include the use of high pressure washers, steam washers or wet brushing; and

- Decontamination areas will be maintained and upgraded as necessary to not allow spillage outside of controlled areas.

7.0 LAND OWNERSHIP AND ACCESS

Generally, ARCO will secure all access agreements with landowners affected by the proposed haul routes. EPA and MDEQ assistance may be requested to the extent that the agencies are willing and able to help with access.

8.0 SCHEDULE OF WORK

The Clark Tailings disposal schedule will result in completing the excavation from LAO sooner than if the materials were hauled to the Opportunity Ponds, as presented in the Phase I, Segment II Expedited Response Action Work Plan. The final closure of the Clark Tailings will be complete in the spring or summer of 1998. Remedial activities at LAO are scheduled to be completed in late fall of 1997 or spring of 1998, approximately 18-22 months ahead of the current Opportunity Ponds scenario. This schedule assumes hauling and other construction activities will commence from March 1 through November/December 1997, and from March 1 to June 1998.

ATTACHMENT 1

Letters from ARCO and the State of Montana Regarding LAO Haul Through the Montana Pole and Treating Plant Site

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711
Telephone 406 563 5211
Facsimile 406 563 8269

February 3, 1997

Mr. Neil Marsh
State Project Manager, Montana Pole
MDEQ
2209 Phoenix Avenue
Helena, MT 59620

Re: Lower Area One (LAO) Haul Through Montana Pole and Treating Plant (MPTP) Site to Clark Tailings

Dear Neil:

This letter hopefully captures all of the technical issues and associated action items which we discussed at our meetings on January 23 and 24 regarding the LAO haul through MPTP. Thank you and your team for taking the time to resolve the remaining issues with me.

Architect and Architect's Building
ARCO will relocate the resident architect, Mr. Harold Godtland, prior to beginning haul road construction through MPTP. This has already been arranged with Mr. Godtland.

ARCO will also demolish the green building (on the south side of the MPTP site) where Mr. Godtland currently conducts business and will place demolition debris at an on-site location designated by you or your representative. ARCO is pursuing separate access arrangements on this site, which will address building demolition. You advised me that the building may have been built in the 1950's and apparently was used as an office and for file storage for MPTP. The resident architect claims that the building does not contain asbestos. You also had no reason to believe that the building was contaminated with MPTP-associated wastes. Nevertheless, ARCO and DEQ will attempt to contract Torger Oaas to obtain more information about past building use.

Sump North of Architect's Building
ARCO plans to cave-in and fill the existing sump north of the architect's building. This will be done in the interest of our haul road safety. As discussed in our meeting, I will notify you in advance so that you can collect subsurface samples from the sump area prior to filling in the excavation.

On-going MPTP Activities
As agreed, MPTP remedial-related activities will have access priority across ARCO's haul road through the MPTP site. It is my understanding that DEQ expects the impact to ARCO's

operations will be minimal and generally limited to: a few days of material haul from the Land Treatment Unit (LTU) in March or April--which would likely involve temporary shut down by ARCO; access to monitoring wells once or twice per week; access to finish construction of and operate the LTU; and occasional access for other miscellaneous purposes. In the interest of safety for all parties involved, I recommend that we meet and establish a protocol for access on or across our haul road. It will also be imperative that the LAO and MPTP contractors have regular communications.

Demolition and Debris

ARCO appreciates your willingness to demolish the two tin buildings on the south end of our proposed road, remove the concrete structures just south of the elevated rail grade (Newcombe Branch) as necessary, and remove and grade approximately 430' of old railroad and underlying ties and soils. DEQ indicated that these items would be conducted and paid for by the State. DEQ would complete these items by the end of February.

LAO Haul Road Plan through MPTP

ARCO's contractor (Barnard) will provide a haul road map, detailed engineering plans, and a written work plan to me early next week. I will forward these documents to you no later than February 5, 1997. The plans will consider such items as maintaining drainage to the storm drain and cleanout structure near the architect's building, drainage patterns south and north of Greenwood Avenue, the haul road grades at and adjacent to the brick processing plants, safe distances away from the MPTP retention pond, recovery trench features, removal and use of elevated rail grade material, the proposed location of the haul road (as accurate as possible), plans for keeping Greenwood Avenue clean, and other issues and limitations. In addition, on-site or imported fill used for haul road construction will be separated from existing MPTP soils by an approximate 4" layer of clean fill overlaid by a geotextile fabric or equivalent means of separation. Imported fill and other haul road features will be removed upon completion of our hauling activities unless you specifically request otherwise.

Elevated Rail Grade (Newcombe Branch) Material

A significant portion of the elevated rail grade material will be removed and permanently disposed at Clark Tailings. Some of the material may be used as haul road fill north and south of the Newcombe Branch, but will be disposed at Clark Tailings when hauling activities are complete. As stated above, a geotextile or equivalent means of separation will be used to separate the rail grade material from MPTP soils and other clean fill.

Boundary Fence Relocation

As you requested, ARCO will relocate your east boundary fence (currently located on the elevated rail grade) to the eastern toe of the elevated grade directly adjacent to Montana Western's active rail line right-of-way. The fence will be located no closer than 12.5' to the centerline of the railroad track--per coordination with Mike Greene (President, Montana Western)--but far enough away from the toe of the fill to accommodate future construction activities. Where appropriate, the fence will be routed back to the top of the elevated grade and

connected with the existing fence. At the north end of the MPTP site, the fence will be connected to your east-west fence and a gate will be placed across our haul road. Access across the northern portion of our haul road and through an additional gate in the relocated fence will be provided for well monitoring. Once again, it is critical that we establish a safety protocol for crossings of our haul road. ARCO will leave the fence at the new location at the end of its activities.

Power Pole Relocation
Montana Power (Curt Quist) believed that relocation of the power poles currently traversing the elevated rail grade was possible. He will evaluate availability of power poles and other items and respond to me next week. I understand that the critical issues to MPTP operations are maintaining sufficient power line height to facilitate future backfilling, and maintaining power drops to the sump pumps, air monitoring stations, and other facilities. Your concerns will be accommodated, and I will discuss the exact power pole relocation plan with you prior to implementation. ARCO will pay power pole relocation costs.

Dust Control
ARCO will require our contractor to maintain adequate dust control. Consistent with LAO requirements, we do not plan to conduct air monitoring, but will use a visual criterion.

Monitoring Well Abandonment/Replacement
The existing monitoring well located north of the architect's building in the center of our proposed haul road will be abandoned per State requirements. Once our hauling operations are complete, we will replace the well. I will look forward to receiving well replacement specifications from Ted Duaime.

Damage Repair
Ron Ziegler's letter of January 24, 1997 to Randy Shepherd (ACCI) describes ARCO's commitment to repair any damage to ACCI's work products caused by the LAO hauling operations through the MPTP site. We will continue to work insurance issues with Randy and other ACCI people. ARCO provides a similar commitment to the State in the event that ACCI's warranty expires prior to completion of our haul. ARCO's legal staff will discuss indemnification requirements separately with DEQ legal staff.

Safety/Security
ARCO will install haul road gates at both the north and south ends of the MPTP site. The south gate will be monitored by flagging personnel during all hours of haul operation and both gates will be closed and locked during off hours. The north gate will be monitored by on-site personnel (i.e., drivers, contractor foremen), but will not necessarily be monitored by a full-time flagger. Safety and site security are of the utmost importance to ARCO, and we hope to work closely with you and our contractors to ensure that all safety issues are addressed.

Schedule

ARCO plans to give Barnard verbal approval to begin haul road construction outside of MPTP as soon as February 24, pending the results of the agency and public approval process. Haul road construction within MPTP may begin as soon as the first week of March. My understanding from Randy Shepherd is that this schedule should not impact ACCI operations and that he plans to install the necessary utilities across our haul road prior to March.

Thank you once again for your continued cooperation.

Sincerely,

Eric Jacobsen
ARCO Construction Supervisor

cc: Sandy Stash/ARCO
Ron Ziegler/ARCO
Chuck Stilwell/ARCO
Dianne Smith/ARCO
Barry Duff/ARCO
Dan Schall/Barnard
Mike Jones/Barnard
Jim Harris/EPA
Ron Bertram/EPA
Ken Brockman/EPA
Randy Shepherd/ACCI
Dick Talley/MSE-HKM

file: 71.03.110.2
Chronological

ATTACHMENT 2

Detailed Haul Road Work Plan and Design

DRAFT

CLARK TAILINGS
HAUL ROAD WORK PLAN

CONTRACTOR: Barnard Construction
OWNER: ARCO
DATE: 2/4/97

WORK ITEMS:

- **Coordination**
- **Build Haul Roads**
- **Protecting I-90 Columns, Railroad, Greenwood Avenue, & Beeftrail Road**
- **Dust Control**
- **Haul Road Maintenance**
- **Traffic Control & Security**
- **Haul Road Restoration**

INTRODUCTION

Nearly one million cubic yards of tailings material from the LAO site will be transported along the haul road to the Clark Tailings disposal site.. This haul road will be built from the southern LAO border to the Clark Tailings. It will cross Silver Bow Creek, Montana Western Railroad, Montana Pole Treatment Plant (MPTP), Greenwood Avenue, Hollow / La Velle property, and Beeftrail Road. This road will have almost constant heavy equipment traffic on it, primarily Cat 769C Trucks. Barnard will operate a 11-hour shift five to six days per week. To utilize maximum daylight, the shift timing will vary slightly throughout the year. A standard shift will be from 7:00am to 6:30pm. Barnard may choose to operate two shifts in the summer months of June, Juiy, and August. Total shift time will be from 5:00am to 9:30pm.

COORDINATION

Barnard will coordinate work efforts with those of ARCO, MPC, ACCI, HolTran, MWRR, State of Montana, Superfund Program and Butte Silver Bow Public Works Department. Any changes to this plan will also be coordinated with the appropriate parties

BUILD HAUL ROADS

Attached is the plan view map (Map 1) and miscellaneous typical details and cross-sections (Figures 1 and 2) for the haul road to Clark Tailings south of the LAO site. The plan view map shows the haul road across existing railroad tracks, on the existing elevated railroad grade, through MPTP south of LAO, across Greenwood Avenue, through Hollow La Velle property, across Beeftrail Road and into the Clark Tailings.

The haul road will be built to the Haul Road Safety Policy Barnard implemented onsite in early September. This policy will be used as a guideline but slight variations may need to be implemented to accommodate specific site features. These site features are the Silver Bow Creek crossing, railroad crossing, I-90 concrete bridge columns, MPTP site, Greenwood Avenue, and Beeftrail Road. Speed limits will be reduced as necessary to accommodate these features. The maximum speed limit may also be increased to 35-MPH on the straight-a-way stretches (such as between Greenwood Ave. and Beeftrail Rd.) where there are no impeding features. A 35-MPH truck speed and the truck brake performance at these speeds are well within the safe limit running on a 2% or less grade for CAT 769C haul trucks according to the CAT handbook. These changes noted above as well as other possible changes will be re-verified and discussed once the haul road is built and prior to operation.

Haul Road from Beeftrail Road to Greenwood Avenue

A Cat D6H Dozer, Cat D8N Dozer, Cat 14G Blade, Cat Roller and a Water Truck will be used to construct the 60 feet wide haul road (outside berm to outside berm) between Beeftrail Road and Greenwood Avenue. All vegetation, trees, and shrubs will be removed and possibly placed at the old Butte Silverbow landfill. Any existing topsoil will either be stripped and stockpiled off to the side of the road or used to build berms that will run parallel with both sides of the road. The function of the berms is to capture contact water within the berms and prevent any runon from the surrounding area to enter the haul road. It may be necessary to build small sediment control structures outside of the haul road right of way to contain excess amounts of surface runon captured within the berms. This excess runon will pool in low areas of the haul road and can be diverted from the haul road to a sediment control structure using a small culvert or a piece of pipe. The purpose of the sediment control structure is to capture any sediments or LAO material spilled onto the haul road. These sediment control structures will be cleaned up when the haul road is restored or as otherwise required. Ditches and culverts will be installed as needed to maintain proper drainage from surrounding areas. Barnard will build the road in a fashion that will allow any existing drainages or drainage structures to

function equal to or better than they did prior to haul road construction. The road will be constructed to have a 50 feet wide driving surface. Any areas requiring fill to achieve this surface will be filled with nearby existing material. The drainage on the south side of Greenwood avenue will be controlled by installing a 12" HDPE culvert under the haul road to permit any surface drainage/runoff to pass under our haul road from the west to the east where it will be carried under Greenwood via the existing culvert.

Haul Road from Greenwood Avenue to LAO

Road Through MPTP

A Cat D6H Dozer, Cat D8N Dozer, Cat 14G Blade, Cat 769 Trucks, Cat Excavator, Cat Roller and a Water Truck will be used to build the 60 foot wide (outside berm to outside berm) haul road with berms from Greenwood Avenue north to the elevated railroad grade. A 3 inch minimum thick layer of decomposed granite will be place on the entire haul road footprint through MPTP site. Any areas of the haul road that require fill from the elevated railroad will have geotextile fabric or equivalent placed on the decomposed granite before any elevated railroad material is placed. When the road is reclaimed, the elevated railroad material used for haul road construction will be placed at Clark Tailings per placement specifications.

The haul road will cross Greenwood Avenue and go under an existing power line to be raised by Montana Power Company. The architect will be relocated by ARCO and the green architect building will be demolished and removed by Barnard. The caving in and filling of an existing sump will also be performed by Barnard. Barnard will inform ARCO and the State of demolition schedule so that the State may collect samples at their discretion. The road will continue through the existing green building location and Barnard will install a culvert under the haul road to the existing 24" HDPE storm water cleanout and a catch basin on the west side of the haul road per ARCO directions. An existing monitoring well will be abandoned according to ARCO's previously submitted well abandonment work plan and the LAO WP/DR requirements. From that point the road will go straight toward the center line offset of the south east corner of the red brick building. In doing so, it will be necessary to remove (by others) two existing tin buildings. Keeping the road as far to the west as possible will ensure a safe distance away from the existing Retention Pond and associated plumbing. The road will parallel the red brick building with centerline of the road being approximately 40 feet west of the structure. This will allow a safe distance from the building as well as keeping a safe distance from the retention pond and associated plumbing. From the north east corner of the red brick building, the road will continue towards the elevated railroad staying to the east of some existing concrete structures. Any additional fill required in this area will come from the elevated railroad. From the north most concrete structure, the road will swing toward the west to line up with the existing north-south portion of the elevated railroad. An existing 24" HDPE storm drain will be extended a minimum of 5 feet beyond any fill placed in that area with sufficient soil cover to prevent damage. The area between the concrete structures and the elevated railroad will be filled with material from the elevated railroad to achieve a gradual grade. This is area will contain the low spot in

the haul road through MPTP property. Barnard will install a 12" diameter poly culvert through the west most haul road berm to drain any water collected on the haul road. This water will drain into and existing infiltration pond west of the haul road. Barnard will build berms of existing railgrade material. Barnard does not anticipate disrupting any existing surface drainage. All equipment used for construction at the MPTP will be decontaminated before leaving the site. After the road is built, any equipment passing through the site on the constructed haul road will not require decontamination procedures.

Figures 1 and 2 attached show details with respect to the haul road through the MPTP site.

Elevated Railroad

The elevated railroad will be excavated from the top down to establish a 45 foot minimum driving surface. After having a Cat D8N Dozer establish a ramp and road surface at the south end of the railroad, a Cat Excavator will be used to excavate the material and place it into trucks to be transported to Clark Tailings to be disposed of per the Technical Specifications. Berms will be left in place on both sides of the road for safety and to control runoff. Any material that falls outside the existing footprint of the elevated grade during haul road construction or hauling operations will be cleaned up and properly disposed of. Both ends of the elevated roadway will either excavated or graded to build a safe and effective haul road.

Railroad Crossing

The existing grade 10 feet of either side of the railroad tracks will be built up with decomposed granite material and slag to the same elevation as the railroad crossing. Existing topsoil will be striped off and replaced with compacted decomposed granite sub-base and approximately 12" of slag from the LAO site or an asphalt apron. The sub-base material will be compacted with a roller at optimum moisture content for adequate compaction. Geotextile fabric (AMOCO 4510) will be placed under the aprons and between the railroad ballast and the sub-base material to eliminate contamination to the ballast material with fines.. The apron surface will be rolled to form a flat drivable surface. The slag will be removed once the crossing is no longer used and returned to the LAO site for proper disposal. Slag is used as the base due to it is angular faced for better compaction and support and that the haul trucks will not track fines across and onto the crossing. Once the railroad crossing is functionable, the equipment needed for building the rest of the haul road will cross the railroad into the MPTP site and continue onto the entrance into the Clark Tailings.

Silver Bow Creek Crossing

Two, 24" HDPE culvert will be installed at Silver Bow Creek to serve as a temporary crossing until all excavation is complete on the LAO site. Barnard will use existing material to backfill the culvert and construct the crossing. The crossing will have a minimum width of 50 feet, enabling 2 haul trucks to use the crossing at the same time.

PROTECTING I-90 COLUMNS, RAILROAD, GREENWOOD AVE. & BEEFTRAIL RD.

Earth berms will be placed along the haul road per our Haul Road Safety Plan. The berm on any portion of the elevated railroad (running parallel) will have a height equal to the axle height of the haul trucks. The berms near the I-90 concrete columns will be either 4 ft in height or have concrete barricades placed around them as was done on the haul road to the west borrow area.

The railroad crossing will be maintained by keeping both approaches stable and level with the top of the crossing. Barnard will also mandate no turning, braking, or quick acceleration while on the crossing. The crossing will be cleaned on a daily basis or more frequently, if necessary, of any possible fine material dropping off of the trucks and any other material that could impact the crossing or railroad.

Barnard does not anticipate any structural impact to Greenwood Avenue or Beeftrail Road. If construction traffic does damage the road surface enough to impede public use, the damage will be repaired by either using steel sheets, repaving, or adding a controlled density fill material (i.e. concrete).

DUST CONTROL

Barnard will control visible dust on the haul road using a water truck and by applying dust abetment chemicals such as magnesium chloride and or calcium chloride. The haul road will be constantly monitored for visible dust by all personnel.

HAUL ROAD MAINTENANCE

The haul road will be maintained as needed. Maintenance will be performed with a Cat 14G Blade. The haul road will be inspected daily by supervision and security guards. Any spillage of LAO excavated materials will be cleaned up and properly disposed of at Clark Tailings on an as needed basis.

TRAFFIC CONTROL & SECURITY

Barnard's current plan is to use a part time security guard at the railroad crossing or stop signs initially, and then eliminate the flagger when signalized crossings are installed. Barnard will also have Montana Western's train dispatcher call and alert us of the approximate time when the next train will be passing across our haul road (usually within 15 minutes). This notification will be also put out to all Barnard truck drivers, equipment operators, and site personnel.

In addition to signage, a full time security guard will be used direct construction and public traffic at Greenwood Avenue and Beeftrail Road and to keep public from inadvertently accessing

the haul road.

Barnard recognizes that security needs to be maintained during construction. Barnard will install a gate constructed of existing like materials used to fence Clark Tailing CWMA. Two 25 foot five bar (cattle type) steel security gates will be installed at the MPTP boundary near Greenwood Avenue. Barnard will relocated the existing chain link fence on the elevated railroad grade to 10 feet from the embankment toe or 12.5 feet west from center line of existing railroad tracks. Barnard will also install two 25 foot swinging chain link gates at the railroad crossing. Other cable and steel post type gates will be installed on the light truck access roads and the 4X4 jeep trails. Obstructions such as steep berm, boulders or other obstructions will be installed to prevent anyone from trying to travel around these gates. Signs will be properly posted in well seen places. Orange safety fence will be installed in areas that could create fall hazards, areas of unstable ground or others areas that have potential to harm people or animals. In order to ensure the safety of the public where Barnard Construction Company, Inc.'s (BCCI) Haul Road crosses Greenwood Road and Beef Trail Road the following traffic control plan will be implemented.

Security Personnel

A full-time Security Person/Flagger will be used at both public street crossings. This person will perform two functions: 1) Will secure any public traffic from entering the Montana Pole Treatment Site, Clark Tailings disposal site, or haul road between Greenwood and Beef Trail Roads. 2) Will direct public traffic safely across the haul road.

Traffic Signs

Four "STOP" signs will be posted, two on each side of the street crossing, 25 ft. away from the Haul Road and facing public traffic. "STOP AHEAD" and "FLAGMAN AHEAD" signs will be posted on each side of the street crossing, 500 ft. away from the Haul Road, facing public traffic. Haul trucks are expected to reach these street crossings once every 1.5 minutes. If Barnard chooses to haul backfill back to the LAO site, a haul truck will be crossing every 0.5 minutes. The Security Person/Flagger will hold a two sided "STOP" sign.

Procedure

All public traffic will stop momentarily at the Haul Road/Public Street intersections. After public vehicles have stopped they will be directed by a Security Person/Flagger to either proceed or wait at the "STOP" signs. The Security Person/Flagger will direct public traffic through the intersection if there are no Haul Trucks at or inside the "timing markers", which are simply visual markers placed along the Haul Road that serve as a visual signal to the Security Person/Flagger. The Security Person/Flagger will hold a two sided "STOP" sign facing the Haul Road while public traffic is crossing the Haul Road. This will alert all Haul Trucks coming to the Street Crossings to slow down and to stop before the crossing. Once the public traffic has cleared the crossing the Security Person/Flagger will turn the two sided "STOP" sign back to the public street, allowing Haul Trucks to proceed. The Security Person/Flagger will hold public traffic at the "STOP" signs using the two sided "STOP" sign, if there are Haul Trucks at or inside of

the "timing markers".

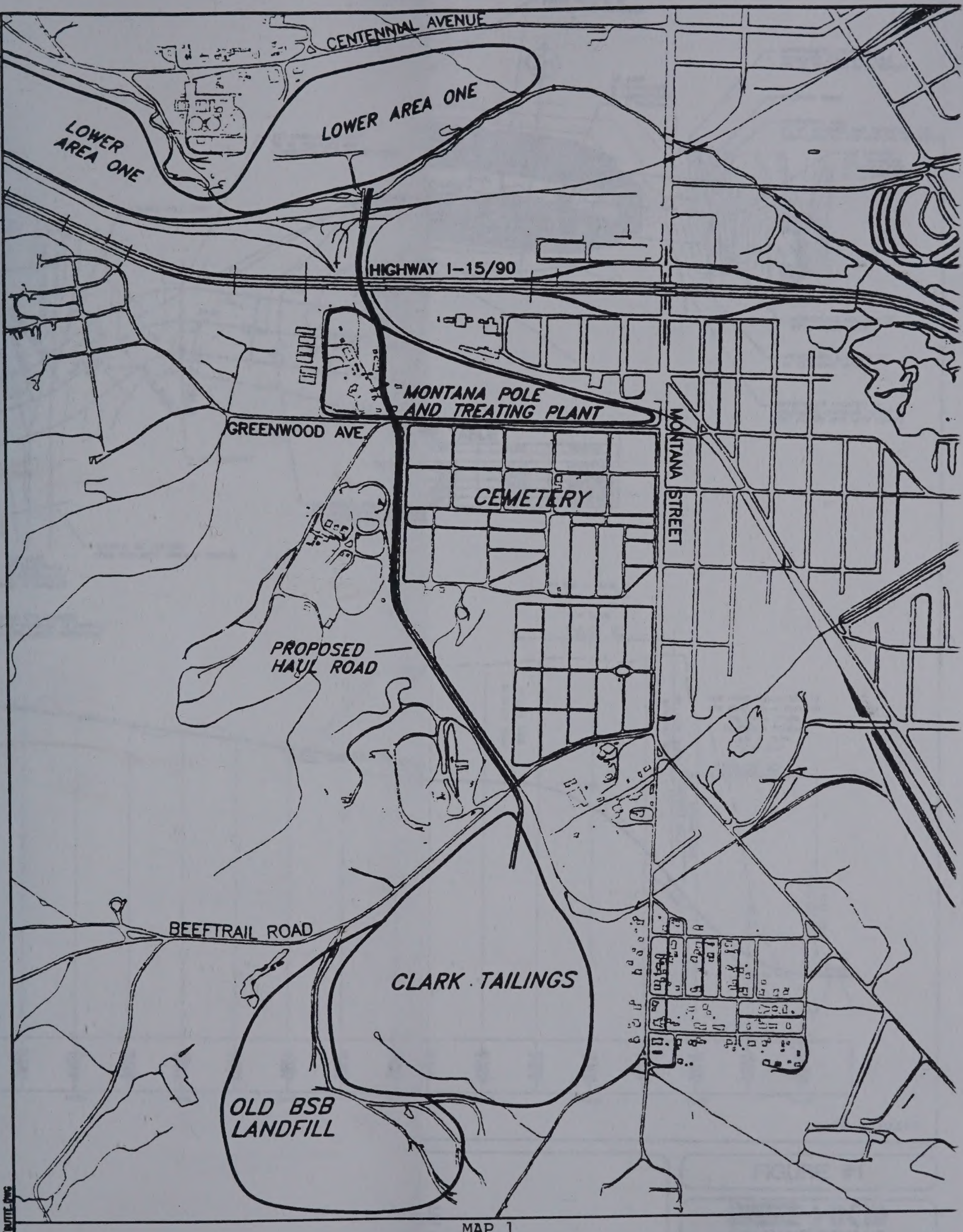
The "timing markers" are placed along the Haul Road, approximately 1000 ft. from the street crossing. The Haul Trucks will take 20 seconds to reach the crossing from the "timing markers", traveling at a maximum speed limit of 30 mph. This time delay from when the haul truck is at the "timing marker" until it reaches the crossing has a safety factor of two, and will ensure that public traffic and Haul Trucks do not meet at the street crossings.

Additional Safety Measures
Haul Truck Operators will look both ways before crossing public streets. Haul Trucks will use their headlights at all time. Haul Trucks will have 2-way radios to communicate hazards or potential hazards. The Security Person/Flagger will have radio communication with Haul Truck Operators, Water Truck Drivers, and Management Personnel. The Security Person/Flagger will stop all traffic in an emergency and radio BCCI's base. Security Personnel/Flagger will wear florescent orange vests, hard hats and safety glasses. Security Person/Flagger will clean crossing on a daily basis or as otherwise required of fine material that may fall from the trucks.

HAUL ROAD RESTORATION

Any spillage of LAO excavated materials will be cleaned up and properly disposed of at Clark Tailings. The road and installed features will be removed, graded, and backfilled as necessary to a similar land shape as existed prior to road construction. The elevated railroad will have the safety berms bladed away from the edge and spread over the top of the railroad. All street damage will be repaired or replaced. Remaining haul road surfaces will be graded and scarified in preparation for revegetation by others. All damaged asphalt will be removed and replaced at Greenwood Avenue and Beeftrail Road. Barnard will coordinate all paving with Butte Silver Bow Public Works Department.

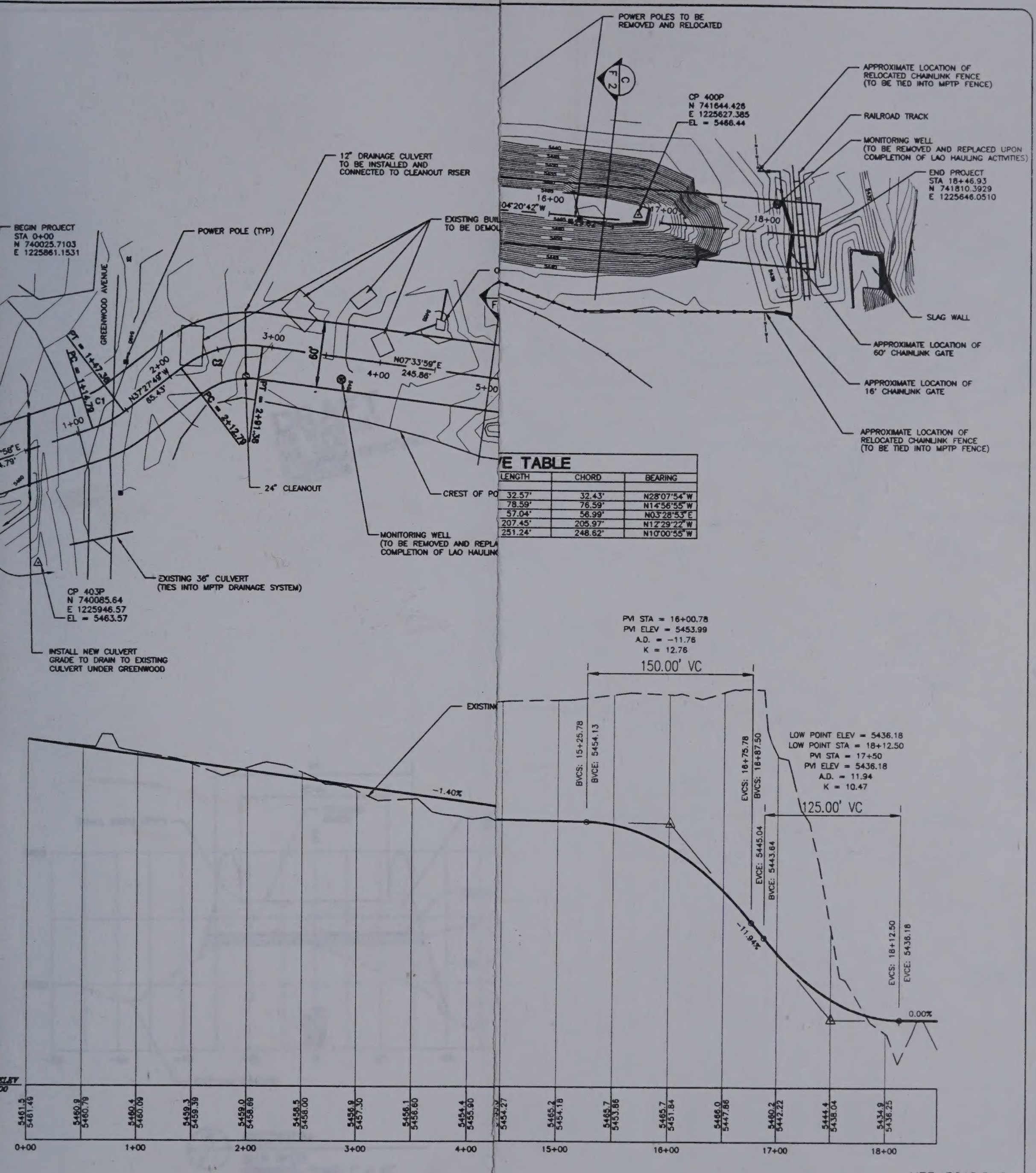
A new monitoring well will be installed on the MPTP site. This well will be installed according to the specifications provided by the Montana Bureau of Mines and Geology.


CENTENNIAL AVENUE
LOWER AREA ONE
LOWER AREA ONE
HIGHWAY I-15/90
MONTANA POLE AND TREATING PLANT
GREENWOOD AVE.
CEMETERY
MONTANA STREET
PROPOSED HAUL ROAD
BEEFTRAIL ROAD
CLARK TAILINGS
OLD BSB LANDFILL

MAP 1

PROPOSED HAUL ROAD: LAO TO CLARK TAILINGS

C:/BUTTEGIS/BUTTE.DWG


POWER POLES TO BE REMOVED AND RELOCATED
C
F 2
CP 400P
N 741644.426
E 1225627.385
EL = 5468.44
APPROXIMATE LOCATION OF RELOCATED CHAINLINK FENCE (TO BE TIED INTO MPTP FENCE)
RAILROAD TRACK
MONITORING WELL (TO BE REMOVED AND REPLACED UPON COMPLETION OF LAO HAULING ACTIVITIES)
END PROJECT
STA 18+46.93
N 741810.3929
E 1225646.0510
12" DRAINAGE CULVERT TO BE INSTALLED AND CONNECTED TO CLEANOUT RISER
EXISTING BUIL
TO BE DEMOL
BEGIN PROJECT
STA 0+00
N 740025.7103
E 1225861.1531
POWER POLE (TYP)
GREENWOOD AVENUE
16+00
17+00
18+00
04°20'42"W
SLAG WALL
APPROXIMATE LOCATION OF 60' CHAINLINK GATE
APPROXIMATE LOCATION OF 16' CHAINLINK GATE
APPROXIMATE LOCATION OF RELOCATED CHAINLINK FENCE (TO BE TIED INTO MPTP FENCE)
PT = 1+47.36
PC = 1+14.79
C1
C2
1+00
2+00
3+00
4+00
5+00
N37°27'49"W
65.43'
N07°33'59"E
245.86'
60'
PC = 2+12.79
PT = 2+91.38
58"E
79'
24" CLEANOUT
CREST OF PO
MONITORING WELL (TO BE REMOVED AND REPLA COMPLETION OF LAO HAULIN
EXISTING 36" CULVERT (TIES INTO MPTP DRAINAGE SYSTEM)
CP 403P
N 740085.64
E 1225946.57
EL = 5463.57
INSTALL NEW CULVERT GRADE TO DRAIN TO EXISTING CULVERT UNDER GREENWOOD
PVI STA = 16+00.78
PVI ELEV = 5453.99
A.D. = -11.76
K = 12.76
150.00' VC
EXISTIN
BVCS: 15+25.78
BVCE: 5454.13
EVCS: 16+75.78
BVCS: 16+87.50
EVCE: 5445.04
BVCE: 5443.64
LOW POINT ELEV = 5436.18
LOW POINT STA = 18+12.50
PVI STA = 17+50
PVI ELEV = 5436.18
A.D. = 11.94
K = 10.47
125.00' VC
-1.40%
-11.94%
EVCS: 18+12.50
EVCE: 5436.18
0.00%
ELEV
00
5461.5
5461.49
5460.9
5460.79
5460.4
5460.09
5459.3
5459.39
5459.0
5458.69
5458.5
5458.00
5456.9
5457.30
5456.1
5456.60
5454.4
5455.90
5454.27
5465.2
5454.18
5465.7
5453.86
5465.7
5451.84
5466.0
5447.86
5460.2
5442.22
5444.4
5438.04
5434.9
5436.25
0+00
1+00
2+00
3+00
4+00
15+00
16+00
17+00
18+00

VE TABLE

LENGTH	CHORD	BEARING
32.57'	32.43'	N28°07'54"W
78.59'	76.59'	N14°56'55"W
57.04'	56.99'	N03°28'53"E
207.45'	205.97'	N12°29'22"W
251.24'	248.62'	N10°00'55"W

MPP-ROAD.DWG

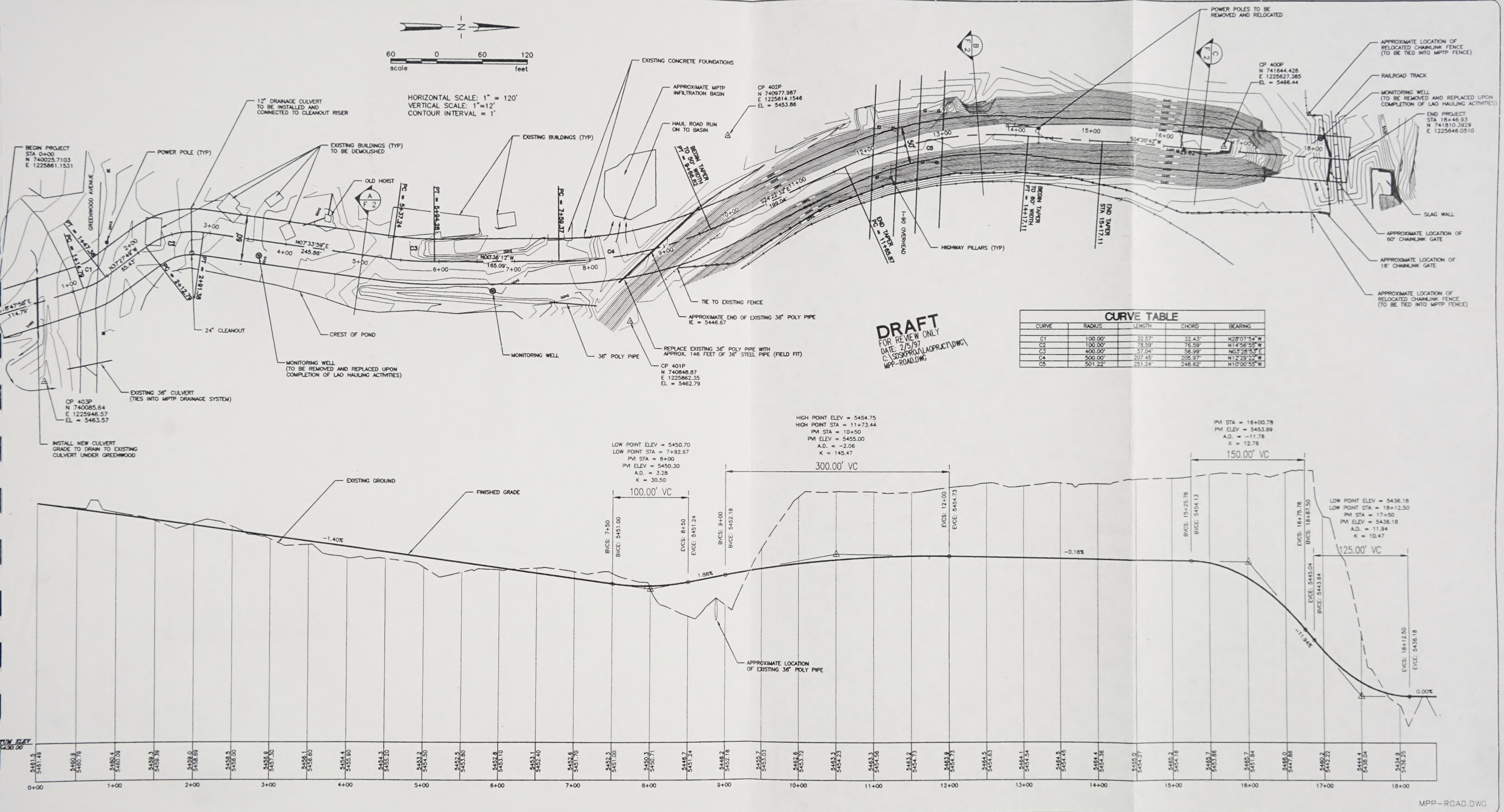
LE
P SITE

FIGURE #1

MSE-HKM
ENGINEERING

15B455.108

2/97


N
60 0 60 120
scale feet
HORIZONTAL SCALE: 1" = 120'
VERTICAL SCALE: 1"=12'
CONTOUR INTERVAL = 1'
BEGIN PROJECT
STA 0+00
N 740025.7103
E 1225861.1531
POWER POLE (TYP)
12" DRAINAGE CULVERT
TO BE INSTALLED AND
CONNECTED TO CLEANOUT RISER
EXISTING BUILDINGS (TYP)
TO BE DEMOLISHED
OLD HOIST
EXISTING BUILDINGS (TYP)
EXISTING CONCRETE FOUNDATIONS
APPROXIMATE MPTP
INFILTRATION BASIN
HAUL ROAD RUN
ON TO BASIN
CP 402P
N 740977.987
E 1225614.1546
EL = 5453.86
GREENWOOD AVENUE
PT = 1+47.36
PC = 1+14.79
C1
C2
C3
C4
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
N37°27'49"W
65.43'
PC = 2+12.79
PT = 2+91.38
60'
N07°33'59"E
245.86'
A F 2
PC = 5+37.24
PT = 5+94.28
N01°36'12"W
165.09'
PC = 7+59.37
BEGIN TAPER
TO 50' WIDTH
PT = 9+66.82
S24°22'32"E
199.04'
50'
B F 2
C F 2
END TAPER
PC = 11+65.87
I-90 OVERHEAD
BEGIN TAPER
TO 80' WIDTH
PT = 14+17.11
END TAPER
STA 15+17.11
S04°20'42"W
24" CLEANOUT
CREST OF POND
MONITORING WELL
(TO BE REMOVED AND REPLACED UPON
COMPLETION OF LAO HAULING ACTIVITIES)
MONITORING WELL
36" POLY PIPE
EXISTING 36" CULVERT
(TIES INTO MPTP DRAINAGE SYSTEM)
CP 403P
N 740085.64
E 1225946.57
EL = 5463.57
INSTALL NEW CULVERT
GRADE TO DRAIN TO EXISTING
CULVERT UNDER GREENWOOD
TIE TO EXISTING FENCE
APPROXIMATE END OF EXISTING 36" POLY PIPE
IE = 5446.67
REPLACE EXISTING 36" POLY PIPE WITH
APPROX. 146 FEET OF 36" STEEL PIPE (FIELD FIT)
CP 401P
N 740848.87
E 1225862.35
EL = 5462.79
HIGHWAY PILLARS (TYP)
POWER POLES TO BE
REMOVED AND RELOCATED
CP 400P
N 741644.426
E 1225627.385
EL = 5466.44
APPROXIMATE LOCATION OF
RELOCATED CHAINLINK FENCE
(TO BE TIED INTO MPTP FENCE)
RAILROAD TRACK
MONITORING WELL
(TO BE REMOVED AND REPLACED UPON
COMPLETION OF LAO HAULING ACTIVITIES)
END PROJECT
STA 18+46.93
N 741810.3929
E 1225646.0510
SLAG WALL
APPROXIMATE LOCATION OF
60' CHAINLINK GATE
APPROXIMATE LOCATION OF
16' CHAINLINK GATE
APPROXIMATE LOCATION OF
RELOCATED CHAINLINK FENCE
(TO BE TIED INTO MPTP FENCE)
LOW POINT ELEV = 5450.70
LOW POINT STA = 7+92.67
PVI STA = 8+00
PVI ELEV = 5450.30
A.D. = 3.28
K = 30.50
100.00' VC
HIGH POINT ELEV = 5454.75
HIGH POINT STA = 11+73.44
PVI STA = 10+50
PVI ELEV = 5455.00
A.D. = -2.06
K = 145.47
300.00' VC
PVI STA = 16+00.78
PVI ELEV = 5453.99
A.D. = -11.76
K = 12.76
150.00' VC
LOW POINT ELEV = 5436.18
LOW POINT STA = 18+12.50
PVI STA = 17+50
PVI ELEV = 5436.18
A.D. = 11.94
K = 10.47
125.00' VC
EXISTING GROUND
FINISHED GRADE
-1.40%
1.88%
-0.18%
-11.94%
0.00%
BVCS: 7+50
BVCE: 5451.00
EVCS: 8+50
EVCE: 5451.24
BVCS: 9+00
BVCE: 5452.18
EVCS: 12+00
EVCE: 5454.73
BVCS: 15+25.78
BVCE: 5454.13
EVCS: 16+75.78
BVCS: 16+87.50
EVCE: 5445.04
BVCE: 5443.64
EVCS: 18+12.50
EVCE: 5436.18
APPROXIMATE LOCATION
OF EXISTING 36" POLY PIPE
DATUM ELEV
5430.00
5461.5 5461.49
5460.9 5460.79
5460.4 5460.09
5459.3 5459.39
5459.0 5458.69
5458.5 5458.00
5456.9 5457.30
5456.1 5456.60
5454.4 5455.90
5454.3 5455.20
5453.2 5454.50
5452.5 5453.80
5452.8 5453.10
5453.1 5452.40
5452.6 5451.70
5452.3 5451.00
5450.3 5450.71
5446.7 5451.24
5448.2 5452.18
5455.7 5453.03
5462.6 5453.72
5463.3 5454.23
5463.3 5454.56
5463.2 5454.73
5463.9 5454.73
5464.5 5454.63
5464.1 5454.54
5464.5 5454.45
5464.4 5454.36
5465.0 5454.27
5465.2 5454.18
5465.7 5453.86
5465.7 5451.84
5466.0 5447.86
5460.2 5442.22
5444.4 5438.04
5434.9 5436.25
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
MPP-ROAD.DWG

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FOR REVIEW ONLY
DATE: 2/5/97
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MPP-ROAD.DWG

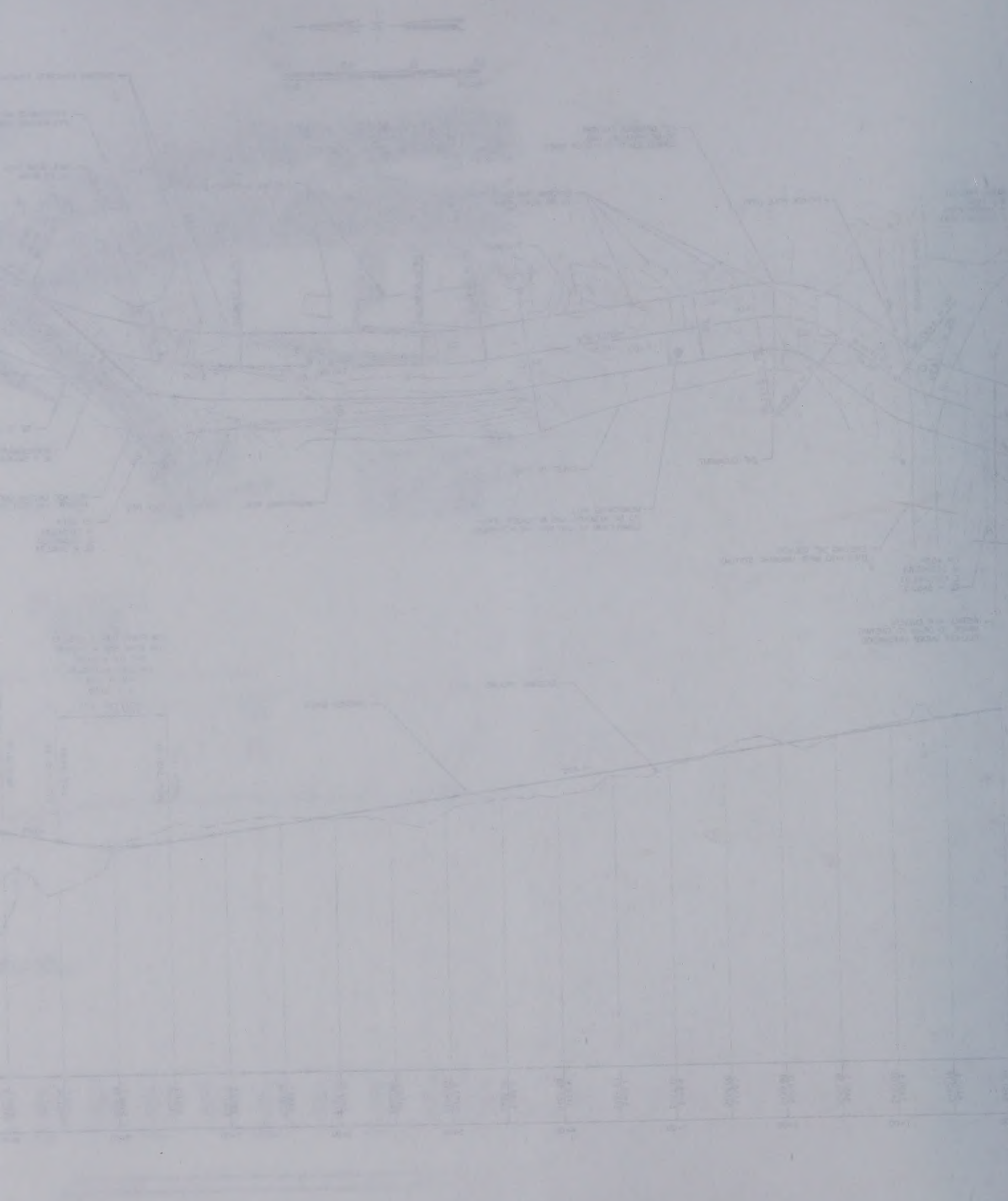
CURVE TABLE				
CURVE	RADIUS	LENGTH	CHORD	BEARING
C1	100.00'	32.57'	32.43'	N28°07'54"W
C2	100.00'	78.59'	76.59'	N14°56'55"W
C3	400.00'	57.04'	56.99'	N03°28'53"E
C4	500.00'	207.45'	205.97'	N12°29'22"W
C5	501.22'	251.24'	248.62'	N10°00'55"W

LOWER AREA ONE
PLAN AND PROFILE
HAUL ROAD THRU MPTP SITE

FIGURE #1

MSE-HKM
ENGINEERING

15B455.108 2/97



LOWER
PLAN AND
HAUL ROAD

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DATE: 2/5/97
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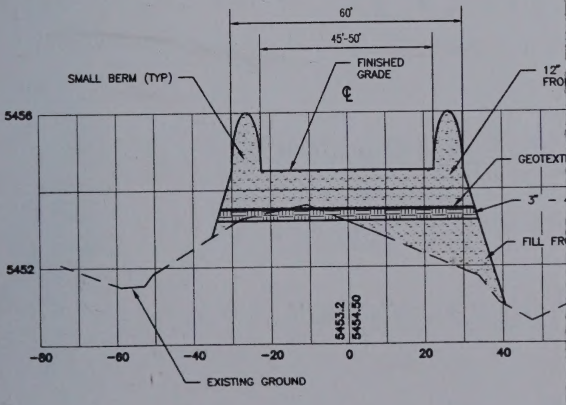
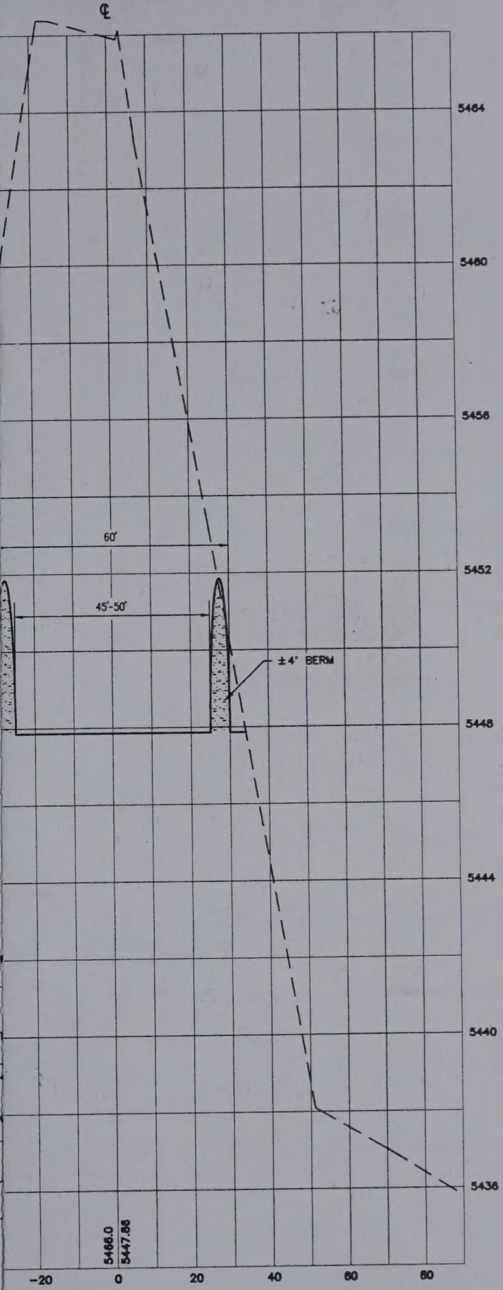

60'
45'-50'
SMALL BERM (TYP)
FINISHED GRADE
℄
12" FRO
GEOTEXT
3" -
FILL FR
EXISTING GROUND
5456
5452
5453.2
5454.50
-80
-60
-40
-20
0
20
40

SECTION

A / F 1

STA 5+00
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 0+00 TO STA 9+33


℄
60'
45'-50'
± 4' BERM
5464
5460
5456
5452
5448
5444
5440
5436
5466.0
5447.86
-20
0
20
40
60
80

SECTION

C / F 1

STA 16+50
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 9+33 TO STA 9+66.82 &
FROM STA 15+17.11 TO STA 18+46.93

TYPSECTS.DWG

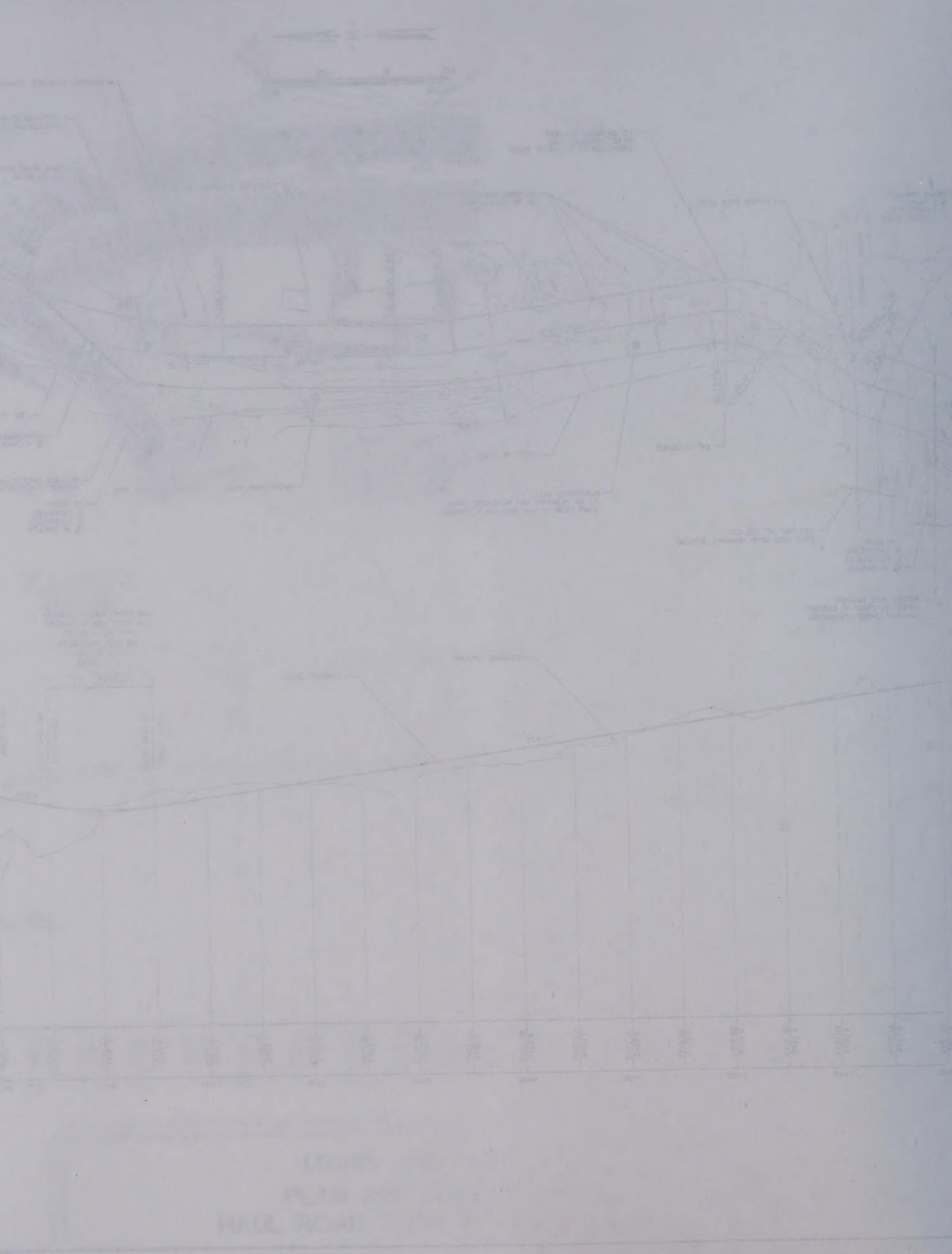
E

TP SITE

FIGURE #2

MSE-HKM
ENGINEERING

15B455.108	2/97


PLAN AND
HILL ROAD

DRAFT
FOR REVIEW ONLY
DATE: 2/5/97
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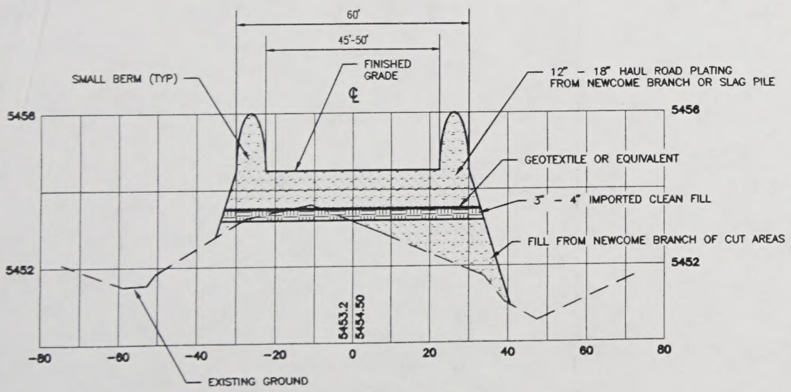
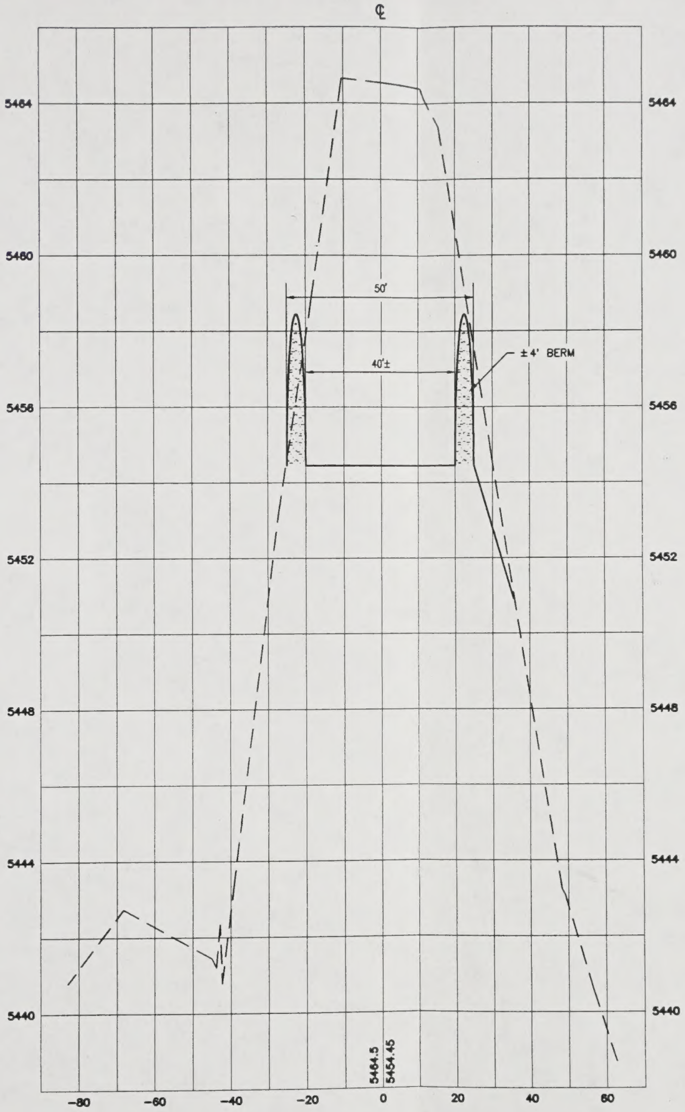
TYPSECTS.DWG


60'
45'-50'
SMALL BERM (TYP)
FINISHED GRADE
℄
12" - 18" HAUL ROAD PLATING FROM NEWCOME BRANCH OR SLAG PILE
GEOTEXTILE OR EQUIVALENT
3" - 4" IMPORTED CLEAN FILL
FILL FROM NEWCOME BRANCH OF CUT AREAS
EXISTING GROUND
5456
5452
5453.2
5454.50
-80
-60
-40
-20
0
20
40
60
80

SECTION A / F 1

STA 5+00
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 0+00 TO STA 9+33

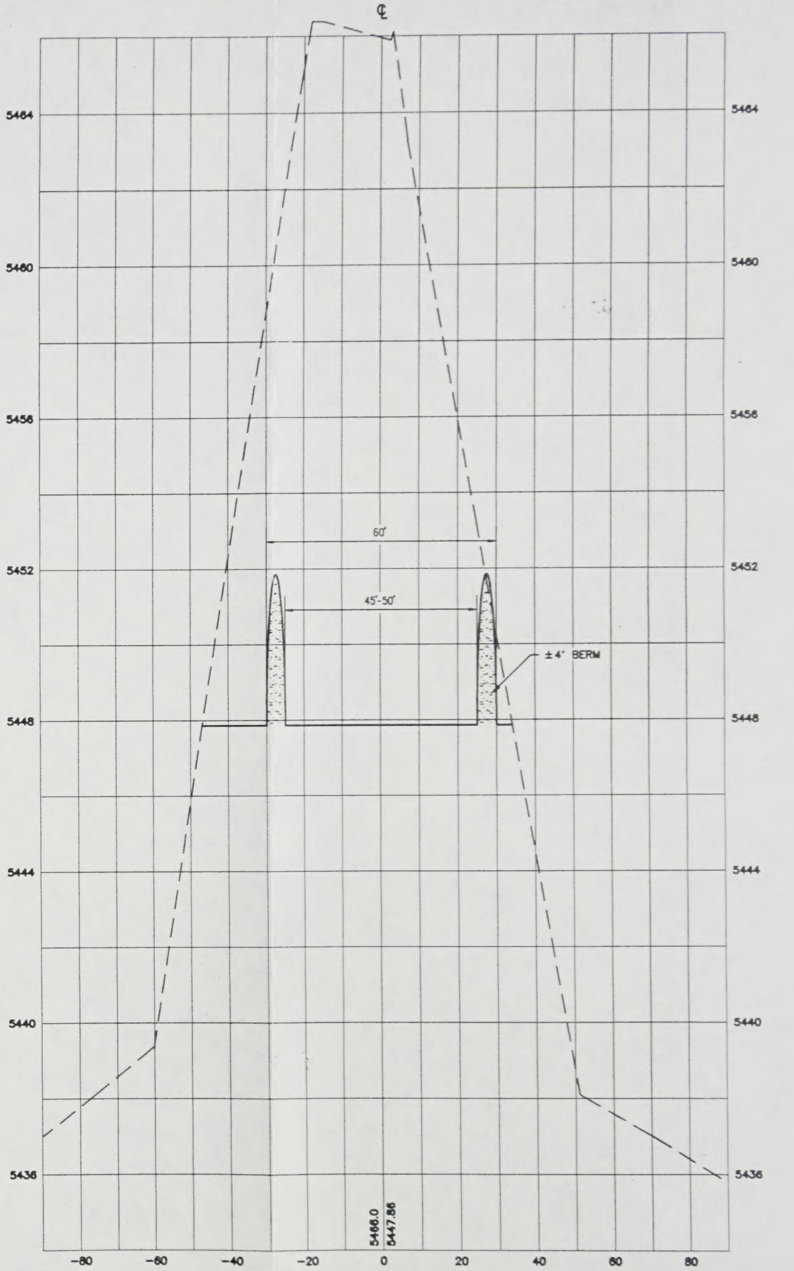

℄
50'
40'±
± 4' BERM
5464
5460
5456
5452
5448
5444
5440
5464.5
5454.45
-80
-60
-40
-20
0
20
40
60

SECTION B / F 1

STA 13+50
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 11+65.87 TO STA 14+17.11

TYPICAL SECTION TAPERS FROM 60' TO 50' FROM STA 9+66.82 TO STA 11+65.87
TYPICAL SECTION TAPERS FROM 50' TO 60' FROM STA 14+17.11 TO STA 15+17.11


℄
60'
45'-50'
± 4' BERM
5464
5460
5456
5452
5448
5444
5440
5436
5466.0
5447.86
-80
-60
-40
-20
0
20
40
60
80

SECTION C / F 1

STA 16+50
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 9+33 TO STA 9+66.82 &
FROM STA 15+17.11 TO STA 18+46.93

TYPSECTS.DWG

LOWER AREA ONE
SECTIONS
HAUL ROAD THRU MPTP SITE

FIGURE #2

MSE-HKM
ENGINEERING
15B455.108 2/97

ATTACHMENT 3

LAO Contractor Health and Safety Plan

BARNARD CONSTRUCTION COMPANY, INC.

LOWER AREA ONE-PHASE I SEGMENT II
CLARK TAILINGS CWMA OPTION
SITE-SPECIFIC SAFETY AND HEALTH PLAN

REVISED FOR 1997

DRAFT

SITE-SPECIFIC SAFETY AND HEALTH PLAN

I. GENERAL INFORMATION

This SITE-SPECIFIC SAFETY AND HEALTH PLAN (SSHASP), in conjunction with the Barnard Construction Company's (Barnard) Health and Safety Manual has been developed to identify, evaluate, and prescribe control measures for safety and health hazards, as well as to provide for emergency response, at the subject sites. This SSHASP format has been developed by BARNARD, and the SSHASP will be completed and fully developed on a site-specific basis by the Barnard Project Representatives, as outlined in the SSHASP. Implementation of the SSHASP, once formulated, will be the responsibility of Barnard. All subcontractors and other affected parties will be subjected to follow this SSHASP. Changes and updates to this SSHASP will be the responsibility of the Barnard's Safety Representative (Bob Kruckenberg). Distribution of all changes and updates will be made by Barnard's Safety Representative (Bob Kruckenberg). Distribution of original copies will be made as follows: Three copies to Barnard, one copy to be kept at the office and one copy to (Dan Schall-Project Manager); and one copy to (Mike Jones-Project Superintendent), one copy to ARCO. Barnard will be responsible for providing a copy of this completed Plan to ARCO for archiving within one week of the completion of this project. Changes and updates shall be made to the on-site and ARCO archive Plans only. Barnard will be responsible for forwarding the SSHASP to all agencies, subcontractors and other parties as required.

SITE AND PROJECT NAME: LOWER AREA ONE (LAO)-PHASE I SEGMENT II CLARK TAILINGS OPTION Butte, Montana

Project Scope and Applicability Test ("TEST")

> **Is the project, in fact, covered by this program in both scope and as applicable? Answer "YES" or "NO" to the following questions.**

1. Is the activity a "clean-up operation" defined in the regulation as "an operation where hazardous substances are removed, contained, incinerated, neutralized,

stabilized, cleaned-up or in any other manner processed or handled with the ultimate goal of making the site safe for people or the environment"? **YES**

2. Are the materials involved in the project actually classified as "hazardous substances" defined in the regulation as "any substance defined under Section 101(14) or 101(33) of CERCLA, listed by the U.S. D.O.T. as a hazardous material under 49 CFR 172.101, or defined as a hazardous waste under 40 CFR 261.3 or 49 CFR 171.8"? **YES**

3. Will the activities be conducted at an "uncontrolled hazardous waste site" defined in the regulation as "an area where an accumulation of hazardous waste creates a threat to the health and safety of individuals or the environment or both"? **NO**

A project meeting all of these criteria is considered to meet the applicability of the regulation (29 CFR Part 1910.120), and the remainder of this PLAN must be completed and adhered to.

If the project does not meet the Applicability of this program, the results of this TEST must be documented and results discussed with workers, as appropriate.

Medical Surveillance Applicability

For projects deemed to be within the scope and applicability of the regulation, a Medical Surveillance Program may be required. To test for this requirement, consider the following criteria.

Will employees wear a respirator for 30 days or more a year or as required by 29 CFR Part 1910.134? **NO**

Are workers members of a HAZMAT team? **NO**

Has any worker been injured due to an overexposure from an emergency incident involving hazardous substances or health hazards? **NO, not on this site or area.**

Are workers likely to suffer overexposure to hazardous substances exceeding Permissible Exposure Limits (PEL's) or other published exposure limits because of the types of contaminants to be encountered, duration of the project, potential for planned activities to produce overexposure, and/or the results of preliminary evaluation air monitoring?
NO, previous monitoring results indicate there has not been exposure above OSHA established Permissible Exposure Limits (PELs) to any of the site hazards.

If future sampling results indicate possible exposures are above OSHA PELs or if site hazardous significantly change, then a Medical Surveillance Program may be adopted if necessary. Barnard's SSO will ensure compliance with any necessary Medical Surveillance Program. Any changes to the Medical Surveillance program will be communicated to all affected parties.

A Medical Surveillance Program is not needed for this Remedial Action

II SITE CHARACTERIZATION

Site Names: Lower Area One-Phase I Segment II, Clark Tailings Option

Site Location: The LAO site is located approximately 0.5 miles west of Butte, Montana adjacent to Interstate 90. The Colorado Tailings is approximately 40 acres. The Butte Reduction Works and related works occupies approximately 80 acres. The Clark Tailings Site lies approximately 1.5 miles south of LAO and is approximately 60 acres.

Approximate size of area where work activities are to be conducted (acres or dimensions): The entire project encompasses approximately 150 acres.

Summary of Project Objectives:

(Refer to Exhibit A-1 and A-2 in the contract Scope of Work as necessary)

The general description of the work to be completed for Segment II of Phase I. The Scope of Work for each method is varied, but is based on eight stages of Work.

Stage 1 Pilot Excavation Project (completed-Fall 95)

Stage 2 Excavate the Silver Bow Creek diversion area, the temporary channel, and excavate and backfill between the Butte-Silver Bow Sewage Treatment Plant and the existing slag wall (completed Fall 1996).

Stage 3 Excavate the new Silver Bow Creek Channel east and west of MPTP Buffer Zone. Excavated material for 1996 was disposed of at Opportunity Ponds disposal site. Excavated material for 1997 and beyond will be disposed of at Clark Tailings disposal site located 1.5 miles south of LAO, via off road haul trucks on constructed haul roads.

Stage 4 Excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill the new Silver Bow Creek channel within the Buffer Zone.

Stage 5 Excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill Butte Reduction Works and Colorado Tailings.

Stage 6 Route Silver Bow Creek into low flow channel and excavate (excavated material will be disposed of at Clark Tailings disposal site) area near sewage treatment plant.

Stage 7 Construct west LAO diversion, excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill west area and route Silver Bow Creek in west end low flow channel.

Stage 8 Construct temporary sedimentation pond and excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill Sedimentation Pond 1 area.

Estimated time for project completion:

Approximately June 1998 or 21 months from project start up date

Anticipated shift schedule (times and days per week): 7:00 a.m. to 6:30 p.m. / 5-6 days per week. Two shifts may by used in the summer months of June, July, August. Total shift time will be from 5:00 a.m. to 9:30 p.m..

ARCO Project Organization:

General Supervisor: Ron Ziegler/Chuck Stillwell
Montana Facility Manager: Sandy Stash
Construction Supervisor: Eric Jacobsen
Environmental Health and Safety Manager: Jim Schrack

Barnard Project Organization:

Operations Manager: Dan Hertel
Project Manager: Dan Schall
Project Superintendent: Mike Jones
Project Engineer: Larry Bowar
Safety Director: Kevin Babcock
Site Safety Officer: Bob Kruckenberg
Lead Foreman: Rick Engle

Subcontractor Personnel

O' Keefe Drilling: Dan O'Keefe
Cashell Engineering: John Cashell
Jordan Construction: Joe Jordan/Jerry Vercella/Bob Lash
Mining City Merchant Police: Bob Cuthill

Other Contractor Personnel

RARUS: Kauz McCarthy/Paul McCarthy
MSE/HKM: Dick Talley
PIONEER: Mark Stratton

Agency Oversight

Butte-Silver Bow County: Rick Larson
EPA: Ken Brockman/Larry Smith
State of Montana: Kevin Kirley

III. CHEMICAL HAZARD ANALYSIS

List those Project Tasks or Phases which may pose hazards from chemical exposures.

PROJECT TASK OR PHASE	**CHEMICAL HAZARD**
All major construction tasks	Arsenic, Cadmium, Lead

Chemical Hazards:

Types of materials expected to be encountered at the site while doing these tasks or phases:
Arsenic, Cadmium, Lead, low pH soils.

The Barnard Site Safety Officer and Construction Company will ensure that OSHA 1910.1200, the Hazard Communications Standard, is complied with on site.

Chemical contaminants expected to be contained in those materials or chemical products to be used in the tasks that meet the definition of "hazardous substances": Identify those that apply.

Arsenic, Cadmium, Lead

Other: Diesel, Creosote, Tar, Gasoline.

Applicable MSDS's and/or chemical fact sheets are located in the job trailer.

Possible Routes of Exposure:.

[✓ Skin Contact] [✓ Inhalation] [✓ Ingestion]

Potential For Exposure over PEL's or Other Published Limits.

[✓ Low] Medium High

Past sampling results at LAO and other similar sites with similar hazards have shown no evidence of overexposure above OSHA PELs to any of the described material. Refer to sampling results in site safety program.

IV. PHYSICAL HAZARD ANALYSIS

List those Project Tasks or Phases which may pose physical hazards to workers at the site.

Project Task or Phase	**Physical Hazard**
All major project tasks	ALL

Potential Physical Hazards: Underline all that apply

A) Cold Stress B) Heavy Equipment Operation C) Heat stress D) Excavation E) Trips/Falls
F) Material Handling G) Manual Lifting H) Noise I) Natural Hazards
J) Electrical Hazards K) Traffic Control (Heavy Equipment/Public Traffic) K)Other Hazards

Refer to Barnard's Safety Manual for safety programs covering the above mentioned hazards.

V. TRAINING REQUIREMENT ANALYSIS

Have all workers for the project received applicable training, as outlined by 29 CFR 1910.120(e)_YES

Copies of the Training Certificates for all personnel will be kept in the site safety program.

Describe the manner in which site-specific training will be conducted for this project.

Pre-entry briefing-All personnel will be given a pre-entry briefing. Also, an overview of Barnard's Safety Enforcement Policy; Accident and Injury Reporting Guidelines; Drug and Alcohol Program; EEO Policy and our Safety Goals for the project. Task/Safety training will be performed on specific tasks such as excavating and trenching; heavy equipment operations and other work activities as outlined in the Scope of Work.

Describe the elements to be covered in site-specific training: Names of Persons Responsible for Site Safety, Safety and Health hazards on-Site, Use of Personal Protective Equipment, Work Practices to Minimize Worker Risks, Engineering Controls, Decontamination Procedures when needed, Emergency Response.

Bob Kruckenberg will be responsible for Site Safety, compliance, and training.
All employees are responsible for implementing sound safety practices.

List all other planned or required training activities related to this project.

OSHA 40 hour Hazardous Waste Operations and Emergency Response Training and 8-hr Refresher Courses as needed. 24-Hour "On the Job Training" Supervised by persons qualified to provide this training. Other necessary safety training as applicable to the Scope of Work.

Safety Meetings will be held whenever necessary, however meetings will be held at a minimum of once per week lasting at least 15 minutes. Safety Meetings will be conducted on-site.

Bob Kruckenberg is responsible for assuring compliance with the training requirements outlined in Barnard's Safety Manual and any applicable safety training applicable to the Scope of Work.

VI. PRE-ENTRY BRIEFINGS AND SAFETY MEETINGS

Prior to the initiation of site activities, a Pre-entry Briefing (including site-specific training) will be conducted by SSO.

SITE SAFETY OFFICER: BOB KRUCKENBERG

TRAINING REQUIREMENTS TO BE ON-SITE:
40-hour Hazardous Waste and Emergency Response (HAZWOPER) certification with 8-hour refresher and Pre-entry briefing.

LOCATION OF SITE-SPECIFIC HEALTH AND SAFETY PLAN; MSDS; BARNARD'S SAFETY MANUAL. (SSHASP, MSDS will be located in Barnard's project trailer and in the on-site employee trailer)

PPE REQUIRED WHILE ON-SITE:
At a minimum, hard hat, steel toed boots, orange safety vest and safety glasses with side shields shall be worn at all times.

Ear plugs shall be required while operating all heavy-equipment or while working in the near vicinity of heavy-equipment.
(This includes generator sets and other equipment which has been identified as a HIGH NOISE AREA)

SITE CHARACTERIZATION: Location of Exclusion Zone; Contamination Reduction Zone and Support Zone. (Site map is located in the project office)

HEALTH AND SAFETY HAZARDS OF SITE:
CADMIUM, ARSENIC, AND LEAD. Past sampling results of LAO and similar projects (LAO Pilot Excavation) showed no exposure above OSHA PELs to cadmium, lead or arsenic. Barnard will be conducting personnel monitoring during the project and the results of the test will be communicated to all affected parties. Results of sampling in HASP.

HEALTH HAZARDS SUMMARY

Contaminant	PEL/REL/TLV	Target Organs	Toxicity	Carcinogen
Arsenic	.01 mg/m^3 (PEL) .002 mg/m^3 (REL) Ceiling .2 mg/m^3 (TLV) IDLH: 100 mg/m^3	skin, kidneys, liver, lungs, lymphatic system	ulceration of nasal septum, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin	Yes
Cadmium	.2 mg/m^3 (PEL) .6 mg/m^3 (PEL ceiling) lowest feasible concentration (REL) .05 mg/m^3 (TLV) IDLH 50 mg/m^3	respiratory system, kidneys, prostate, blood	pulmonary edema, dyspnea, cough, chest tightness, chills, headache, muscle aches, nausea, vomiting	Yes
Lead	.05 mg/m^3 (PEL) .001 mg/m^3 (REL)	GI tract, CNS, kidneys, blood,	weakness, lassitude, insomnia, facial pallor, anorexia, colic, anemia, eye	No

	IDLH - 700 mg/m^3	gums	irritation	

HEAVY EQUIPMENT/TRAFFIC SAFETY:: Personnel shall make eye contact with operators when working near any heavy equipment. Do not position or park vehicle in equipment blind spots-even if you are stopping for a few seconds. Stay at least 15 feet away from any running or moving equipment. Do not approach equipment unless instructed by operator.
Only Haul traffic and BCCI's supervisors are allowed on haul roads between borrow source/LAO and Clark Tailings Disposal Site/LAO. A safety meeting (JSA's and Work Plans) will be conduct for the Clark Tailing Disposal Option and Borrow Source Haul Road, for all affected employees. Other safety meetings regarding heavy equipment/traffic safety will be conducted as needed, determined by the SSO. Everyone who intends to go onto the site shall observe the haul routes posted on the side of the job trailer, but keep in mind that haul routes are subject to slight variations. All traffic should observe haul traffic patterns before entering the haul route.

Heavy equipment always has the right-of-way. Do not pass heavy equipment. When driving behind any equipment stay in view of the driver's side mirror. Follow posted haul routes and watch for changes. (Posted outside and inside of trailer)

SEAT BELTS WILL BE WORN AT ALL TIMES WHILE ON SITE. (This includes light duty vehicles) The LAO site speed limit is 25 MPH. Higher speeds will be allowed for haul traffic when conditions allow it to be done safely. (Clark Tailings haul max. speed is 35 mph where there are no impeding features and road conditions are good.)
HEADLIGHTS WILL BE USED BY ALL VEHICLES ON SITE. Heavy equipment and light duty vehicles.

EXCAVATIONS: No one is authorized to enter any open excavation or trench unless it has been properly protected (i.e., shored, sloped or other) and been deemed safe for entry by the SSO or other appropriate supervisor.

OTHER: Trips/Fall hazards.
UTILITIES-electrical lines and HPGL are located on project.
Heat/Cold Stress.

EMERGENCY PROCEDURES:

1. All work will stop immediately All unnecessary equipment shall be moved clear to provide clear access to the emergency site. Control site access roads shall be kept open.
2. Contact SSO/Supervisor/Other Site Personnel who have a radio or cell phone.
3. CALL 911- Site is located at 1200 Centennial Avenue.
4. A foreman or other designated person will go to the gate to meet all responding services.
5. Make area safe for everyone, or isolate hazardous area. Secure the site from further hazards, i.e., turn off utilities, remove hazardous substances not involved, etc.
   DO NOT ALLOW ANYONE TO ENTER THE EMERGENCY SITE UNLESS IT IS DEEMED SAFE.

6. All personnel nearby the accident/injury site shall gather all available First Aid/Rescue equipment.
   First Aid Kit/Eye Wash Station/Stretcher are located in office trailer.
   Fire Extinguishers-located on all heavy equipment and project office .
   For fires in the incipient stage, personnel shall extinguish the fire with a fire extinguisher.
   DO NOT FIGHT FIRES IF THEY ARE BEYOND THE INCIPIENT STAGE.
7. List/Identify personnel trained in First Aid/CPR.
8. Emergency numbers and map to hospital are located in office trailer.
9. Do not discuss details of incident with media. You may discuss details of incident with proper emergency or responding personnel.
   Barnard/ARCO will be responsible for all communication with media personnel.

DECONTAMINATION PROCEDURES:

Location of decontamination station(s). Outside of office trailer and on-site.

HEAVY EQUIPMENT: All heavy equipment that permanently leaves the site shall be decontaminated with a power washer which includes washing: tires, under carriage, boxes and any other visible contaminants. Haul traffic and light duty vehicles leaving and returning to LAO do not need to be decontaminated every time they leave the site, unless there are obvious contaminants which could be deposited outside the site on roadways or other areas. SSO or Barnard personnel shall inspect equipment prior to leaving site.

PERSONNEL DECONTAMINATION: Boot brush and wash station shall be used prior to leaving site and prior to food consumption.
Site Safety Meetings will be conducted with workers, as necessary, to keep personnel apprised of changes to the PLAN, as well as changes in site conditions or operations that may impact safety and health hazards. Records of Safety Meetings will be kept in the Site Safety Program.

VII. ENGINEERING CONTROLS, WORK PRACTICES AND PERSONAL PROTECTIVE EQUIPMENT

Based upon the Chemical and Physical Hazards Analyses, and the associated risks, specify Engineering Controls and Work Practices to be implemented by a Project Task or Phase. Examples include covering materials with clean soil, wetting down materials to eliminate exposure possibilities, and use of closed cabs on equipment.

DUST SUPPRESSION/SITE SAFETY

The work described in this Plan has the potential to generate airborne dust. Measures shall include the application of water to haul roads and access roads to suppress dust during the project.
If PELs and other published exposure limits may be exceeded even with the implementation of Engineering Controls and Work Practices, select the appropriate level of PPE by Project Task or Phase.

Level of Protection for all tasks will be level D unless deemed otherwise.

Level D is described as Steel toed boots, safety glasses, and a hard hat. This ensemble will be the minimum protection while in the exclusion zone for the above mentioned tasks. Gloves will be used as needed. When work duties necessitate employees to be working on foot near heavy equipment they shall wear coats, shirts or vests that are fluorescent orange in color.

The particular brands of safety equipment need not be specified.

For respirator usage to protect workers from iron, zinc, manganese or cadmium employees must use a NIOSH/ MSHA approved half or full face respirator with a HEPA filter.

Barnard's Safety representative will be responsible for choosing the proper respiratory protection based on worker exposure data and employee needs. For nuisance dust a NIOSH/MSHA approved cloth respirator will be used.

List the Procedures for maintenance and care of PPE or refer to Barnard's Safety Manual.

Maintenance and care of PPE is the responsibility of each individual employee with the SSO ensuring compliance.

VIII. AIR MONITORING REQUIREMENT ANALYSIS

All air monitoring will be conducted in accordance with published ACGIH, OSHA or other applicable guidelines. Monitoring will be conducted in accordance with any applicable terms of the ARCO/Barnard Contract.

Initial Entry Monitoring

Is the site and task well-characterized and/or previously monitored? **YES**

If "YES", attach results of these analyses to this PLAN and go on to next section, "Site Control". Copies of monitoring results will be kept in the SSHASP.

Periodic Monitoring

Will Periodic Monitoring for IDLH or other hazardous atmospheres be necessary throughout the project? **NO, unless deemed necessary by SSO.**

Personal (Worker) Monitoring

Is it known with a high degree of certainty (based upon the Initial Entry Monitoring or other data) that worker exposures will not exceed PELs or other published exposure limits?_**YES**

If "YES", describe decision rationale and attach supporting documentation. Similar projects where sampling has been conducted showed that exposure to the described particulates were below the established OSHA PEL's. Refer to SSHASP for sampling results.

IX. SITE CONTROL EVALUATION AND ANALYSIS

Site Communication

Are conditions expected that would render verbal communications difficult or impossible?

NO

PROJECT WORK ZONES

Support Zone--(outer boundaries will be marked with orange markers-this area, in general, covers an area 100 yards wide from the North gate to the south end of Barnard's construction trailer.)

Exclusion Zone--(the entire site except the Support and Contamination Reduction Zone)

Contamination Reduction Zone (south end of office trailer, west of trailer, and in lunch trailer)

Refer to Site Map posted on the inside of Barnard's trailer

Barnard shall establish appropriate decontamination areas, Decontamination Procedures. These decontamination areas shall consist of:

A). A Vehicle Decontamination Area. Is located west of Barnard's trailer. All heavy equipment leaving the site permanently will be required to go through proper decon procedures and pass inspection of the SSO. Haul traffic and Light duty vehicles leaving and returning to LAO will not be required to go through decon procedures unless there is an excess amount of contamination on the vehicle. Decontamination procedures are as follows:

1. Spray off tires;
2. Spray off blade/box/bucket, and;
3. Spray off any other visible contamination.

B). Barnard shall furnish and install a mobile personnel cleanup trailer that provides a wash area and boot brush. Personnel and subcontractor personnel are only expected to be subject to minor contact with mine tailings, which can be removed by brushing off and/or washing with soaps/ detergents and rinsing with water. Barnard will also provide soap, water, and disposable towels for hand and face washing. A personnel decon station with soap, water, paper towels, trash can, boot spray and boot brush is positioned on the south end of Barnard's trailer.

Site Security

List all planned precautions to secure the site from unauthorized personnel entry during off-hours.

A security gate that is controlled from the job trailer or similar type of means will be used to provide security. Access roads to LAO from borrow sources and Clark Tailings disposal site will be controlled using security personnel during operations and security gates when roads are not in use. Appropriate signs and other safeguards will be used as needed.

If security problems become a concern, Barnard will develop and implement other measures necessary to protect the site.

X. DECONTAMINATION PROCEDURES

List the equipment and rinsing agents to be used for decontamination for this project.

High Pressure washer. Boot brush and hand washing station.

1. Vehicle Decontamination

Because there are not extensive tailings to be encountered, vehicles will not be decontaminated prior to leaving the site, unless the SSO determines that such action is needed unless visible tailings on vehicles or spilled tailings on public roads are apparent. Barnard shall provide clean materials on surfaces of access roads entering and exiting the sites, in order that personal vehicles do not become contaminated. The collected soils and sediments shall be incorporated with relocated tailings or disposed of at ARCO's direction.

2. Personnel Decontamination

Barnard shall furnish a wash area. Since personnel are expected to be subject only to minor personal contact with the site material, in nearly all cases any exposure would be limited to contact with boots/shoes. The material on-site can be removed from boots/shoes by brushing off and/or washing with soaps/detergents and rinsing with water. Barnard will also provide soap, water, and disposable towels on the site for hand and face washing.

XI. SITE ILLUMINATION/SANITATION REQUIREMENTS

Describe illumination plans for the site if night work is anticipated.

Not anticipated.

Describe provisions made for sanitation and potable water at the site.

Portable toilettes will be located throughout the site.

Potable water is provided in the Barnard trailer and near the work location in a water jug.

XII. EMERGENCY RESPONSE AND SPILL CONTAINMENT PLAN

Location map for the hospitals is posted inside Barnard's trailer on the wall. A list of personnel with the name and phone number of a person to contact in case of an emergency is posted on the wall in Barnard's trailer.

ARCO

NAME	**DAY PHONE NO.**	**EVENING PHONE**
Sandy Stash	563-5211 x 417	494-1032
Jim Schrack	563-5211 x 412	490-0804
Ron Zeigler	563-5211 x 418	490-1320
Chuck Stillwell	563-5211 x413	
Eric Jacobsen	563-5211 x 425	723-7065

Barnard

NAME	*DAY PHONE NO.*	*EVENING PHONE NO*
Dan Hertel	586-1995	585-9032
Dan Schall	723-1121	582-0241
Mike Jones	723-1121	282-7875
Bob Kruckenberg	723-1121	782-2411
Kevin Babcock	586-1995	285-4828

RARUS

Kauz McCarthy	563-2661
Paul McCarthy	563-2821

MT. Western RR

Dispatcher/Bill Blisch	782 - 1240

Burns Security

Ron Wilson	563-3723/491-0056	454-1691
Clean-up Contractors		
SRM	782-4201	800-735-8964
Olympus, Helena	443-3087	
ROAR Tech, Spokane	509-535-6757	
Police, Fire, Ambulance	911	
Disaster Emergency Services, Montana State Emergency Response Coordinator	800-426-9440	444-6911
Disaster Emergency Services, Silver Bow County	782-1515	782-5411
Disaster Emergency Services, Anaconda-Deer Lodge County	560-4000	563-5174
Agency Contacts		
National Response Center	800-424-8802	
EPA Oversight		
Larry Smith	855-2047	
Ken Brockman	855-2046	
State Department of Environment Quality, Superfund Group		
Neil Marsh	444-1420	
Jim Scott	444-1401	

MEDICAL FACILITIES:

Saint James Community Hospital, 400 South Clark, Butte, MT. 59701
Phone 911 or 782-8361

ARCO

307 East Park Street, Suite 400
Anaconda, Montana 59711
Telephone 406 563 5211
Facsimile 406 563 8269

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MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

March 14, 1997

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Re: Submittal of Addendum for Clark Tailings
Lower Area One Administrative Order on Consent for the Lower Area One (LAO) Non-Time Critical Removal Action
EPA Docket No. CERCLA-VIII-92-17

Dear Sirs:

Please find enclosed Final Addendum 1 to the LAO Phase I, Segment II Work Plan Design Report. The final Addendum includes revisions based on agency and public comments which ARCO has received and discussed with agency personnel.

Sincerely,

for CTS

Chuck Stilwell, P.E.
Project Manager

CTS:EJ:tjb 1

cc: Jim Harris, EPA
Ken Brockman, EPA
Larry Smith, EPA
Neil Marsh, MDEQ
Pat Crowley, MDEQ
Bob Alexander, CDM
Bill Melvin, BSB County Commissioner
Charlie O'Leary, BSB County Commissioner
Jon Sesso, BSB
Jimmy Johnston, BSB
Dan Dennehy, BSB
Dave Schultz, BSB
Randy Shephard, ACCI
Dick Talley, MSE
Todd Erickson, MSE-HKM
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file: 71.03.110.1
71.03.110.2
Chronological

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COMMUNITY SERVICES BUREAU

PHASE 1, SEGMENT II EXPEDITED RESPONSE ACTION LOWER AREA ONE OPERABLE UNIT WORK PLAN/FINAL DESIGN REPORT

Addendum 1
Clark Tailings Alternate Repository

For
Lower Area One Operable Unit
Silver Bow Creek/Butte Area (Original Portion)
Superfund Site

Prepared for and by:
Atlantic Richfield Company
307 E. Park, Suite 400
Anaconda, Montana

March 14, 1997

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ATTACHMENTS 1 - 4

1. Letters from ARCO and the State of Montana regarding LAO haul through the MPTP.
2. Detailed Haul Road Work Plan and Design.
3. LAO Site Specific Health and Safety Plan (SSHASP).
4. Air Monitoring Program for Clark Tailings Hauling Activity.

1.0 INTRODUCTION

The purpose of this Addendum is to describe the regulatory framework, planning, schedule, design work, and physical implementation required for placing excavated materials from Lower Area One (LAO) at the Clark Tailings site. Clark Tailings is the alternate disposal location to the Opportunity Ponds. The possibility of an alternate disposal location was described in the Phase I, Segment II LAO Expedited Response Action Work Plan/Design Report (LAO WP/DR). The implementation of this Addendum is subject to changes pending actual field conditions and agency approval. The Segment II LAO WP/DR remains effective and is altered only as specifically described herein.

EPA and the Montana Department of Environmental Quality/Solid Waste Program (MDEQ/SWP) are the regulatory bodies governing placement of LAO materials at Clark Tailings. The excavation and transport of the LAO materials remain under the authority of EPA in accordance with CERCLA and applicable and relevant and appropriate requirements (ARARs) previously identified for the project. This Addendum describes the transportation route and activities between the LAO and Clark Tailings sites and some clarifications to appropriate elements of the LAO WP/DR. Closure of the Clark Tailings site is under the initial jurisdiction of MDEQ/SWP and applicable Resource Conservation and Recovery Act (RCRA), Montana Solid Waste Management Act (MSWMA), and applicable Montana solid waste regulations at Title 17, Chapter 50 of the Administrative Rules of Montana (ARM). Details regarding closure and long-term monitoring of the Clark Tailings site are not included in this Addendum, but may be found in the "Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment" (CMA) and associated design documents.

ARCO plans to complete the LAO removal action and capping at Clark Tailings no later than mid-summer 1998, but perhaps as early as late-1997 depending on weather, date of approval to proceed, and other factors.

2.0 BACKGROUND

Original discussions regarding the use of the Clark Tailings as a possible site for disposal of LAO wastes occurred over four years ago. ARCO and the agencies began discussing again the possibility of an alternative location to place materials excavated from the LAO as part of the Phase I, Segment II Expedited Response Action in late 1995. On-going discussions and development of information to support the use of the Clark Tailings site as an alternative location have occurred since early 1996.

The Clark Tailings disposal location is being proposed as an alternative to the Opportunity Ponds. No further disposal of LAO materials at Opportunity Ponds will occur if Clark Tailings is approved.

3.0 OBJECTIVES

The regulatory requirements in selecting an alternative location include:

- choose a location and design that meets RCRA, MSWMA, and applicable ARM 17.50 regulations; and
- be at least as protective of human health and the environment as the Opportunity Ponds location.

In addition to satisfying the regulatory requirements, other objectives in selecting an alternative location include:

- allow for quicker completion of the LAO expedited response action, thus allowing for better sequencing of other projects including Butte Priority Soils and Streamside Tailings; and
- complete closure or removal actions at LAO, Clark Tailings and the Old Butte-Silver Bow Landfill concurrently.

Placement of the LAO materials at the Clark Tailings will meet the aforementioned regulatory requirements and objectives. Closure under solid waste regulations will ensure that the plan is protective of human health and the environment and complies with applicable solid waste regulations. Primarily because of the shorter haul and the higher rate of haul afforded by off-road trucks, placement at the Clark Tailings will allow for a substantially quicker completion of the LAO Phase I, Segment II Expedited Response Action. Furthermore, the expedited schedule will allow for better sequencing at other sites, including Butte Priority Soils and Streamside Tailings.

4.0 CLARK TAILINGS DISPOSAL SITE

The Clark Tailings, along with the adjacent Old Silver Bow County Landfill, is in the process of being closed in accordance with applicable solid waste regulations at ARM 17.50. The integrated closure of the Clark Tailings and Old BSB Landfill under RCRA and MSWMA has been agreed to by the EPA and MDEQ (Wardell to Lynch, 3/1/95, and Robinson to Lynch, 3/23/95). These letters state that the applicable authorities will be used to close, remediate, and monitor the Clark Tailings/Old BSB Landfill area.

Superfund authority over this area will be used only if the RCRA or MSWMA authorities prove to be inadequate.

Closure of Clark Tailings involves capping the imported LAO and existing Clark Tailings materials in accordance with the BSB Landfill/Clark Tailings CMA and associated design documents. The infiltration barrier material source will be the excavated LAO peat/clay to the extent it is available and can be segregated from tailings during excavation per the Clark Tailings Technical Specifications and BSB Landfill/Clark Tailings CMA. If the peat/clay cannot be properly segregated from the LAO tailings, although previous test pads in the summer of 1996 show that it can, another local infiltration barrier borrow source (e.g., Hollow's or Blankenship's) will be used.

Expected end-land use at Clark Tailings is a public recreational complex. The "Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment" and associated design documents include further details about the repository to be located at Clark Tailings.

5.0 LAO MATERIALS TRANSPORTATION PLAN

This section describes routing, design, construction activities and maintenance of the haul road for transporting excavated materials from LAO to the Clark Tailings. Attachment II includes a plan view of the haul route, haul road design details, and a written work plan describing material transport. LAO materials which are required to be excavated to the agreed contours will be transported to and placed at the Clark Tailings. Additionally, all materials resulting from LAO excavations below the agreed to excavation contours shall be transported to and placed at the Clark Tailings/Old BSB Landfill site.

5.1 HAUL ROUTE AND EQUIPMENT

The haul between LAO and Clark Tailings will generally be a two-lane, one road haul. Starting from LAO and moving south, the proposed road crosses the Montana Western railroad track, transects the MPTP site, crosses Greenwood Avenue, traverses the old rail grade between Greenwood Avenue and Beeftrail Road, and crosses Beeftrail Road to the Clark Tailings site. The only interaction between the public and the haul will be the crossings at Greenwood Avenue and Beeftrail Road. (See Map 1, Attachment II.)

Rigid frame, 35-50 Ton haul trucks will leave LAO loaded to Clark Tailings and return either empty or loaded with clean backfill for LAO. Continuous hauling will occur up to 11 hours per day, 6 days per week.

5.2 DESIGN, CONSTRUCTION, AND HAUL GUIDELINES

Detailed haul road design drawings and a work plan are included in Attachment II. Haul road design, construction and hauling guidelines will generally include the following.

- Two way haul roads will be built to a 50-foot travel width and a 25-foot travel width for one-way roads (curves may require a larger travel width).
- Elevated haul roads will be constructed with a safety berm to a minimum of truck axle height.
- Haul traffic speed will be limited to 35 miles per hour on straight, off-road stretches.
- Haul traffic speed will be reduced to 30 miles per hour or less across railroad tracks and public roads. Safe speed limits through the MPTP will be coordinated with the State Department of Environmental Quality.
- Haul traffic speed around curves will be designated appropriately for the curve radius.
- Haul road grades will be limited to no more than 12% unless otherwise approved.
- Materials placed as fill to construct the haul road will be graded or removed and transported to the Clark Tailings or another approved location during removal/reclamation of the haul roads.
- Haul road design will not adversely impact existing drainage patterns, sedimentation ponds, or other constructed features at MPTP or other locations.
- Culverts will be installed or extended as needed to maintain adequate drainage throughout the transportation route. These culverts will be maintained and periodically cleaned to ensure they function as intended.
- Silt fence, straw bales, or the equivalent will be installed and maintained where required to prevent siltation of active streams (i.e., Silver Bow Creek).
- One or more crossings will be constructed across Silver Bow Creek as needed for hauling tailings and fill materials. The crossing will be constructed similar to that shown on Detail 2-2, Sheet 2-9 of the LAO construction drawings.

- One at-grade rail crossing--constructed of rail ties and pre-cast concrete--will be installed on the Montana Western Railroad, near the northeast corner of the MPTP site. An automated signal light crossing sytem will be installed at this crossing to Federal Railroad Administration (FRA) standards. Safe crossing policies and procedures will be determined jointly by Montana Western, ARCO and its Contractor.

- It is anticipated that some noise will be generated during working hours; however, the nearest residential area is approximately 1,000 feet from the haul road, and no more noise than is currently generated by the nearby interstate or the MPTP site activities is anticipated.

- Road crossing and public safety issues are addressed in Section 6.0 of this document.

- Where the haul road crosses under the I-90 overpass, interstate piers will be protected with earthen berms, Jersey concrete barriers, or both. Field surveys have been completed to show that there is sufficient space for the haul road between the I-90 bridge piers.

- Adequate vertical clearance to the bottom of the I-90 bridge girders will be maintained.

5.3 MONTANA POLE AND TREATING PLANT SITE CONSIDERATIONS

The proposed haul route to Clark Tailings transects the MPTP site as shown on the map in Attachment II. ARCO and its Contractor will continue to work cooperatively with the State and its Contractor to address unforeseen issues. Issues addressed thus far are described in the documents found in Attachments I and II. A summary of these issues follows below.

5.3.1 Elevated Rail Grade (Newcome Branch)

The Newcome Branch is an abandoned railroad embankment which lies on the eastern border of the MPTP site. A substantial portion, or all, of the Newcome Branch embankment will be removed, as determined by the State, to construct a safe and adequate haul road from LAO to the Clark Tailings. Details regarding haul road construction on the elevated grade are found in Attachment II and summarized below.

- The elevated grade will be cut down at least 7 to 12 feet to accommodate two-way traffic with safety berms. It is possible the entire grade may be removed to accommodate the LAO haul road and the MPTP project.

- Contaminated material excavated from the grade will be hauled to the Clark Tailings for disposal by ARCO. Clean material may be used as fill for temporary ramps and haul road depressions within the MPTP site. Material used as temporary haul road surface fill will be separated from existing MPTP soils by a thin layer of imported clean fill overlaid with geotextile or equivalent to maintain physical separation between original grade and temporary fill.

- The chain-link security fence that currently exists on top of the railroad grade will be removed and relocated (by ARCO) to the eastern toe of the railroad grade to accommodate the haul road. The fence will be placed no closer than 12.5' to the centerline of the adjacent railroad line, but far enough from the toe of the grade to accommodate future construction activities. The fence will remain in its new location after completion of LAO hauling activities.

- The power poles and air monitoring stations currently located on the grade will be relocated (by ARCO) to locations approved by MPTP project representatives.

5.3.2 Additional MPTP Issues

Additional issues with respect to the LAO haul road transecting the MPTP site are listed below.

- Current MPTP remedial activities will retain access priority through the MPTP site. Specific access points across the LAO haul road (e.g., near the corners of the MPTP treatment unit) will be installed and maintained. Coordination efforts between LAO and MPTP will avoid schedule or operational impacts to either project.

- The function and integrity of MPTP site drainage facilities, specifically those south and north of Greenwood Avenue and immediately south of the Newcome Branch grade, will be maintained. The LAO haul roaD will be slightly graded north of Greenwood Ave. to minimize run-on, and drainage will be installed south of Greenwood, under the haul road, so as to avoid run-on to the MPTP site.

- For security purposes, haul road access gates will be installed in the fences on the north and south ends of the MPTP site. These gates will be closed and locked during off hours. Gates and other possible entrances to the haul road will be monitored by haul truck drivers, construction foremen, or flagmen.

- The architectural firm leasing the green building adjacent to Greenwood Avenue will be permanently relocated. ARCO will obtain the necessary permits for, and will perform demolition of the building and adjacent sump.

- The on-site resident at MPTP (Oaas) will either be relocated or safety precautions will be discussed between ARCO and the resident and implemented as necessary.

5.4 HAUL ROAD MAINTENANCE

The haul roads will be maintained on a frequent basis to minimize dust from haul traffic, collect spilled or tracked tailings, and maintain the quality of the road. General haul road maintenance items include the following.

- Haul roads and berms will be graded with a motor patrol, or equivalent.

- Water trucks and/or chemical applications (e.g., magnesium chloride) will be used to control dust.

- Approaches to the public road crossings will be coated with coarse gravel for 100 feet on both sides of the crossings.

- Precautions when loading trucks and dewatering excavated material will be taken to minimize spillage. Such precautions include employing qualified operators and drivers, not overloading trucks, and proper dewatering plans.

- Spilled or tracked tailings on the haul roads (excluding public crossings) will be collected on an as-needed basis and disposed at the Clark Tailings.

- Infrequently spilled or tracked LAO materials at public road crossings will be removed immediately to prevent public vehicles from tracking spilled material.

6.0 HEALTH AND SAFETY ISSUES

6.1 GENERAL HEALTH AND SAFETY

Hauling activities between LAO and the Clark Tailings will conform to all federal, state, and local rules and regulations. Contractor truck drivers, equipment operators, and supervisory personnel will be trained and capable of performing their duties in a safe manner. Construction equipment inspections and maintenance will be performed on a regular basis.

ARCO and its Contractor will maintain frequent communications with public officials, MPTP representatives and contractors, and affected landowners to ensure that proper safety measures are implemented.

6.2 TRAFFIC CONTROL/PUBLIC SAFETY

As described in Section 5.1 above, interaction between the proposed haul and the public is limited to two intersections--one at Greenwood Ave. (near the MPTP site) and one at Beeftrail Road (near Clark Tailings). The public road crossings at Greenwood Avenue and Beef Trail Road will be signed and flagged as per the Federal Manual of Uniform Traffic Control Devices. Haulage across the two intersections will be continuously monitored and controlled by flagmen. Public traffic will be prohibited from haul roads by flagmen during regular shifts and by gates during non-working hours.

Approximately one haul truck every 90 seconds will be crossing public roads. Haul trucks will be given the right-of-way by flagmen. Public traffic will be safely signaled through the crossing as haul traffic dictates. Public traffic delays are expected to be 30 - 45 seconds on average, with occasional longer delays.

6.3 DECONTAMINATION OF EQUIPMENT

Equipment which is used at LAO or the Clark Tailings and contains visible tailings will be decontaminated prior to leaving the site onto publicly traveled roads or other jobs. No decontamination of equipment will be completed for travel between LAO and Clark Tailings on the primary haul road, or between LAO and other haul areas accessed by off-road haul equipment. For off-road haul and public road crossings associated with off-road haul, roads will be controlled, maintained and cleaned as discussed in Sections 5.3 and 6.2.

Where equipment decontamination is required, decontamination procedures will include, at a minimum, the following:

- Contact water from equipment decontamination will be captured and contained on the site.
- Sediment from the decontamination facilities will be routinely disposed at the Clark Tailings after drying.
- Equipment that requires wet washing will be completed within LAO or Clark Tailings, with contact water captured and managed in a manner to prevent infiltration into the Clark Tailings fill (e.g., use of lined catch basins);

- Equipment, if dry, will be brushed clean using approved procedures;
- Wet washing will include the use of high pressure washers, steam washers or wet brushing; and
- Decontamination areas will be maintained and upgraded as necessary to not allow spillage outside of controlled areas.

6.4 AIRBORNE DUST CONTROL AND MONITORING

As previously stated, dust will be controlled at LAO, the haul road, Clark Tailings, and borrow source areas by water trucks and/or chemical applications. During non-working hours, a loaded water truck will be stationed on-site and on "on-call" driver will be available at all times. Contact names and numbers of ARCO and Contractor for the public and agencies on a board at the Clark Tailings site, included in media releases, and are included in Attachment 3, Site Specific Health and Safety Plan. ARCO and/or its Contractor will respond as quickly as possible to public or agency concerns.

Air monitoring for dust will be performed as described in Attachment 4. In summary, air monitoring will be conducted as follows.

- Monitoring will be performed throughout the length of the project.
- Daily monitoring will be performed with a Miniram real-time monitor. Miniram results will be correlated to PM10 standards.
- Dust (PM 10) will be monitored and analyzed at least once every six days, perhaps more frequently as described in Attachment 4. Heavy metals (As, Cd, Cu, Pb, and Zn) will be analyzed quarterly using the three highest PM10 or TSP samples collected during the quarter. Monitoring frequency may vary depending on the time of year, agency or public concerns, results of analysis, or other factors.
- Monitoring locations will be near the Boulevard neighborhood and at several locations around Clark Tailings.
- Monitoring results will be evaluated and corrective measures will be taken immediately to address any air quality problems.

7.0 LAND OWNERSHIP AND ACCESS

Generally, ARCO will secure all access agreements with landowners affected by the proposed haul routes. EPA and MDEQ assistance may be requested to the extent that the agencies are willing and able to help with access.

8.0 SCHEDULE OF WORK

The estimated Clark Tailings disposal schedule will result in completing the excavation from LAO sooner than if the materials were hauled to the Opportunity Ponds, as presented in the Phase I, Segment II Expedited Response Action Work Plan and attached hereto. The final closure of the Clark Tailings will be complete in the spring or summer of 1998. Removal activities at LAO are scheduled to be completed in late fall of 1997 or summer of 1998, approximately 18-22 months ahead of the current Opportunity Ponds scenario. This schedule assumes hauling and other construction activities will commence from March 1 through November/December 1997, and from March 1 to July 1998. Nothing in this paragraph or the attached estimated schedule alters the schedule for the LAO NTCRA action contained in the LAO Work Plan (Exhibit 1 to the LAO Order on Consent).

9.0 REPORTING

Air monitoring results will be reported to local, state, and federal agencies as described in Attachment 4. Monthly and final construction reporting requirements will remain the same as stipulated in the LAO Consent Order.

Lower Area One Expedited Response Action

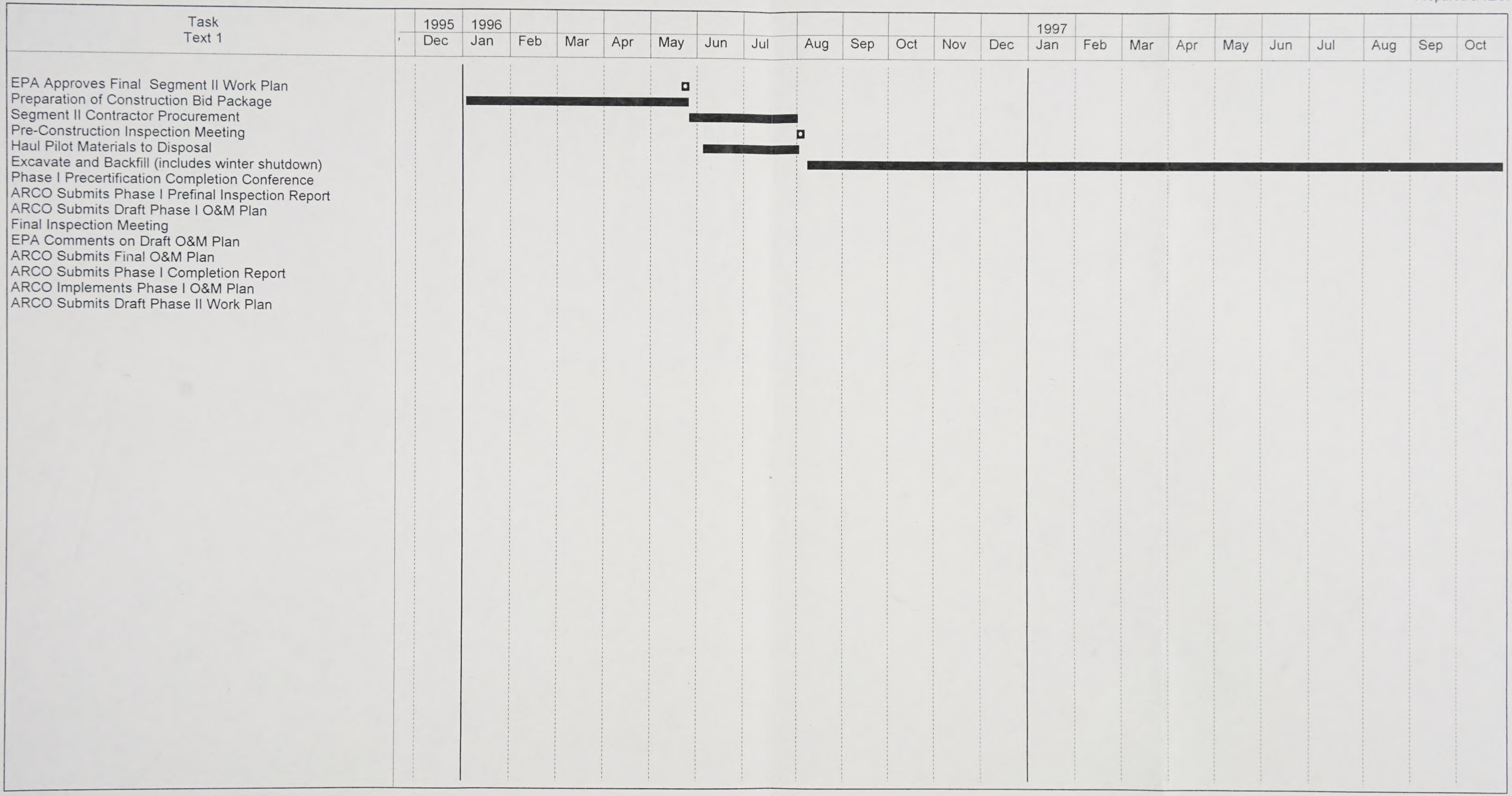
Prepared 3/12/97

Task Text 1	Apr	May	Jun	Jul	Aug	Sep	Oct
EPA Approves Final Segment II Work Plan							
Preparation of Construction Bid Package							
Segment II Contractor Procurement							
Pre-Construction Inspection Meeting							
Haul Pilot Materials to Disposal							
Excavate and Backfill (includes winter shutdown)	■	■	■	■	■	■	■
Phase I Precertification Completion Conference							
ARCO Submits Phase I Prefinal Inspection Report							
ARCO Submits Draft Phase I O&M Plan							
Final Inspection Meeting							
EPA Comments on Draft O&M Plan							
ARCO Submits Final O&M Plan							
ARCO Submits Phase I Completion Report							
ARCO Implements Phase I O&M Plan							
ARCO Submits Draft Phase II Work Plan							

Lower Area One Expedited Response Action

Phase I, Segment II Proposed Schedule
(Clark Tailings Disposal Option - 5000 cy/day)

Prepared 3/12/97



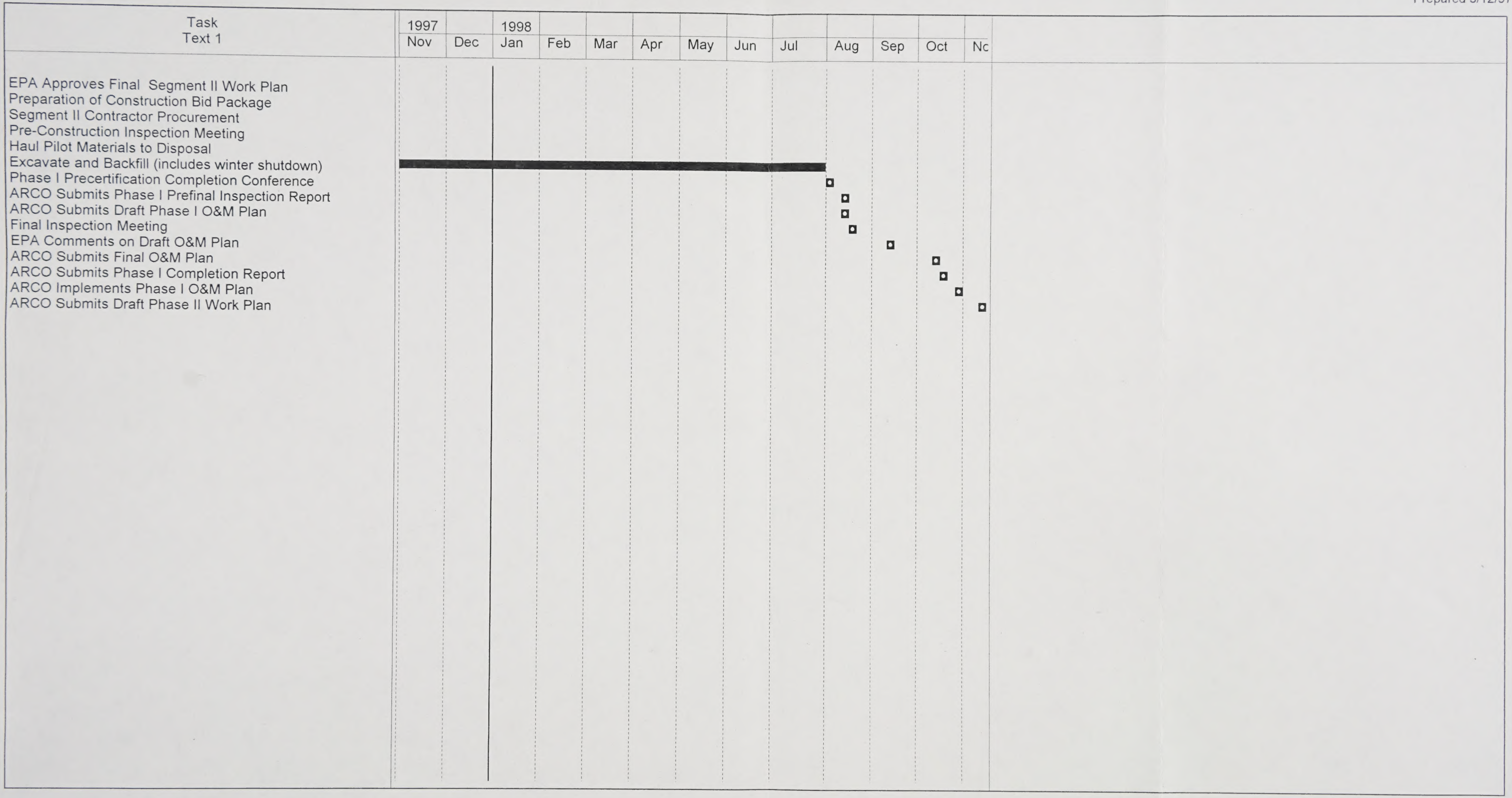
ATTACHMENT 1

Letters from ARCO and the State of Montana Regarding LAO Haul Through the Montana Pole and Treating Plant Site

Phase I, Segment II Proposed Schedule
(Clark Tailings Disposal Option - 5000 cy/day)

Lower Area One Expedited Response Action

Prepared 3/12/97



ATTACHMENT 1

Letters from ARCO and the State of Montana Regarding LAO Haul Through the Montana Pole and Treating Plant Site

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711
Telephone 406 563 5211
Facsimile 406 563 8269

February 3, 1997

Mr. Neil Marsh
State Project Manager, Montana Pole
MDEQ
2209 Phoenix Avenue
Helena, MT 59620

Re: Lower Area One (LAO) Haul Through Montana Pole and Treating Plant (MPTP) Site to Clark Tailings

Dear Neil:

This letter hopefully captures all of the technical issues and associated action items which we discussed at our meetings on January 23 and 24 regarding the LAO haul through MPTP. Thank you and your team for taking the time to resolve the remaining issues with me.

Architect and Architect's Building
ARCO will relocate the resident architect, Mr. Harold Godtland, prior to beginning haul road construction through MPTP. This has already been arranged with Mr. Godtland.

ARCO will also demolish the green building (on the south side of the MPTP site) where Mr. Godtland currently conducts business and will place demolition debris at an on-site location designated by you or your representative. ARCO is pursuing separate access arrangements on this site, which will address building demolition. You advised me that the building may have been built in the 1950's and apparently was used as an office and for file storage for MPTP. The resident architect claims that the building does not contain asbestos. You also had no reason to believe that the building was contaminated with MPTP-associated wastes. Nevertheless, ARCO and DEQ will attempt to contract Torger Oaas to obtain more information about past building use.

Sump North of Architect's Building
ARCO plans to cave-in and fill the existing sump north of the architect's building. This will be done in the interest of our haul road safety. As discussed in our meeting, I will notify you in advance so that you can collect subsurface samples from the sump area prior to filling in the excavation.

On-going MPTP Activities
As agreed, MPTP remedial-related activities will have access priority across ARCO's haul road through the MPTP site. It is my understanding that DEQ expects the impact to ARCO's

operations will be minimal and generally limited to: a few days of material haul from the Land Treatment Unit (LTU) in March or April--which would likely involve temporary shut down by ARCO; access to monitoring wells once or twice per week; access to finish construction of and operate the LTU; and occasional access for other miscellaneous purposes. In the interest of safety for all parties involved, I recommend that we meet and establish a protocol for access on or across our haul road. It will also be imperative that the LAO and MPTP contractors have regular communications.

Demolition and Debris
ARCO appreciates your willingness to demolish the two tin buildings on the south end of our proposed road, remove the concrete structures just south of the elevated rail grade (Newcombe Branch) as necessary, and remove and grade approximately 430' of old railroad and underlying ties and soils. DEQ indicated that these items would be conducted and paid for by the State. DEQ would complete these items by the end of February.

LAO Haul Road Plan through MPTP
ARCO's contractor (Barnard) will provide a haul road map, detailed engineering plans, and a written work plan to me early next week. I will forward these documents to you no later than February 5, 1997. The plans will consider such items as maintaining drainage to the storm drain and cleanout structure near the architect's building, drainage patterns south and north of Greenwood Avenue, the haul road grades at and adjacent to the brick processing plants, safe distances away from the MPTP retention pond, recovery trench features, removal and use of elevated rail grade material, the proposed location of the haul road (as accurate as possible), plans for keeping Greenwood Avenue clean, and other issues and limitations. In addition, on-site or imported fill used for haul road construction will be separated from existing MPTP soils by an approximate 4" layer of clean fill overlaid by a geotextile fabric or equivalent means of separation. Imported fill and other haul road features will be removed upon completion of our hauling activities unless you specifically request otherwise.

Elevated Rail Grade (Newcombe Branch) Material
A significant portion of the elevated rail grade material will be removed and permanently disposed at Clark Tailings. Some of the material may be used as haul road fill north and south of the Newcombe Branch, but will be disposed at Clark Tailings when hauling activities are complete. As stated above, a geotextile or equivalent means of separation will be used to separate the rail grade material from MPTP soils and other clean fill.

Boundary Fence Relocation
As you requested, ARCO will relocate your east boundary fence (currently located on the elevated rail grade) to the eastern toe of the elevated grade directly adjacent to Montana Western's active rail line right-of-way. The fence will be located no closer than 12.5' to the centerline of the railroad track--per coordination with Mike Greene (President, Montana Western)--but far enough away from the toe of the fill to accommodate future construction activities. Where appropriate, the fence will be routed back to the top of the elevated grade and

connected with the existing fence. At the north end of the MPTP site, the fence will be connected to your east-west fence and a gate will be placed across our haul road. Access across the northern portion of our haul road and through an additional gate in the relocated fence will be provided for well monitoring. Once again, it is critical that we establish a safety protocol for crossings of our haul road. ARCO will leave the fence at the new location at the end of its activities.

Power Pole Relocation

Montana Power (Curt Quist) believed that relocation of the power poles currently traversing the elevated rail grade was possible. He will evaluate availability of power poles and other items and respond to me next week. I understand that the critical issues to MPTP operations are maintaining sufficient power line height to facilitate future backfilling, and maintaining power drops to the sump pumps, air monitoring stations, and other facilities. Your concerns will be accommodated, and I will discuss the exact power pole relocation plan with you prior to implementation. ARCO will pay power pole relocation costs.

Dust Control

ARCO will require our contractor to maintain adequate dust control. Consistent with LAO requirements, we do not plan to conduct air monitoring, but will use a visual criterion.

Monitoring Well Abandonment/Replacement

The existing monitoring well located north of the architect's building in the center of our proposed haul road will be abandoned per State requirements. Once our hauling operations are complete, we will replace the well. I will look forward to receiving well replacement specifications from Ted Duaime.

Damage Repair

Ron Ziegler's letter of January 24, 1997 to Randy Shepherd (ACCI) describes ARCO's commitment to repair any damage to ACCI's work products caused by the LAO hauling operations through the MPTP site. We will continue to work insurance issues with Randy and other ACCI people. ARCO provides a similar commitment to the State in the event that ACCI's warranty expires prior to completion of our haul. ARCO's legal staff will discuss indemnification requirements separately with DEQ legal staff.

Safety/Security

ARCO will install haul road gates at both the north and south ends of the MPTP site. The south gate will be monitored by flagging personnel during all hours of haul operation and both gates will be closed and locked during off hours. The north gate will be monitored by on-site personnel (i.e., drivers, contractor foremen), but will not necessarily be monitored by a full-time flagger. Safety and site security are of the utmost importance to ARCO, and we hope to work closely with you and our contractors to ensure that all safety issues are addressed.

Schedule

ARCO plans to give Barnard verbal approval to begin haul road construction outside of MPTP as soon as February 24, pending the results of the agency and public approval process. Haul road construction within MPTP may begin as soon as the first week of March. My understanding from Randy Shepherd is that this schedule should not impact ACCI operations and that he plans to install the necessary utilities across our haul road prior to March.

Thank you once again for your continued cooperation.

Sincerely,

Eric Jacobsen
ARCO Construction Supervisor

cc: Sandy Stash/ARCO
Ron Ziegler/ARCO
Chuck Stilwell/ARCO
Dianne Smith/ARCO
Barry Duff/ARCO
Dan Schall/Barnard
Mike Jones/Barnard
Jim Harris/EPA
Ron Bertram/EPA
Ken Brockman/EPA
Randy Shepherd/ACCI
Dick Talley/MSE-HKM

file: 71.03.110.2
Chronological

DEPARTMENT OF ENVIRONMENTAL QUALITY

MARC RACICOT, GOVERNOR

STATE OF MONTANA

(406) 444-2544

PO BOX 200901
HELENA, MONTANA 59620-0901

March 10, 1997

Mr. Eric Jacobsen
ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

Dear Eric:

Subject: Haul of Lower Area One Wastes Through Montana Pole Site

This letter responds to your February 3, 1997, summary of our discussions to make sure that all technical concerns related to the transport of Lower Area One (LAO) wastes through the Montana Pole and Treating Plant (MPTP) site have been adequately addressed. This exchange of letters is intended to specify how the actions at the two sites are to be coordinated. The Montana Department of Environmental Quality (DEQ) appreciates ARCO's efforts in resolving these issues of concern.

Your letter accurately represented our discussions and the resolutions agreed to by ARCO and DEQ. The commitments provided by ARCO on all technical items addressed in your letter are acceptable to DEQ. This letter provides additional clarification of ARCO's and DEQ's respective commitments in the following areas.

1. **Coordination with ongoing MPTP activities.** We will have limited construction and prove-out activities underway through May 1997 and then on-going treatment operations throughout your proposed haul period. Our contractors will be instructed to maintain regular communication with you and your contractors in an attempt to provide advance notice of any MPTP activity that would involve crossing your haul road.

   Our approval of your haul across MPTP has been premised on ARCO's representations that your haul activities and removal of the haul road would be completed by end of summer 1998. Since the treatment of the first lift of soils in the MPTP land treatment unit may be done by that time and we may then be ready to transport the treated soils back to the north part of our site by October 1998, any delays on your project that would result in your continued hauling past late summer 1998 might give rise to significant conflicts with our MPTP actions. In such case, the terms and conditions of ARCO's access would have to be revised as determined necessary by DEQ to prevent any interference with any MPTP

activities at that time. Please be sure to keep us informed of your schedule for completion of haul activity as it progresses.

2. **Haul road design.** The commitments identified in your letter are consistent with our discussions. I provided comments on the LAO Work Plan Addendum (Attachment 2) to Ron Bertram of EPA on March 4, 1997, with a copy to you. I need to correct one item in those comments; our access to the land treatment unit will be at its southwest corner, not its northwest corner. When you begin your haul road construction, please consult with Joe Newton, our site engineer, regarding final design elements, such as drainage needs, final grade locations and elevations, construction sequencing, etc. You and I discussed several of these items last Friday by telephone. DEQ will flatten out the proposed haul road sub-base near the old MPTP treatment process building. ARCO will place approximately 4 inches of clean fill working from south to north, without contacting MPTP-contaminated soils, prior to placing its geotextile liner. We appreciate your working with us to address our concerns.

   The excavation of the elevated railroad berm has been addressed in another letter I sent to you earlier today.

3. **Power pole relocation.** We met with you during February to discuss the best route for providing power to the MPTP water treatment plant and the Butte-Silver Bow (BSB) sewer lift station. I understand that you have coordinated with Joe Newton in selecting the final pole and guy locations, and that you'll be installing the new lines this week. Please coordinate with our water treatment plant operators and the BSB Metro Sewer Department to schedule appropriate timing for any necessary power outages.

4. **Site safety and security.** Preventing unauthorized access to the MPTP site through the haul road access points will be the sole responsibility of ARCO. During portions of the ARCO action, DEQ will have no personnel at the site. DEQ will not have security guards at MPTP after our initial construction activities are complete. Your present plan does not utilize a full-time flagger at the north haul road gate, but relies on other personnel of ARCO and its contractors to prevent unauthorized access into the Montana Pole site. DEQ suggests that ARCO utilize berms and a final fence configuration in this area that will discourage anyone from attempting to drive or walk onto the haul road or into the Montana Pole site from public roads and railroads immediately northeast of MPTP. Care must be taken to either close the gates or provide other means of controlling access during periods of work shutdown, such as lunch breaks. ARCO's obligations in preventing unauthorized access through the gates are detailed in separate correspondence from Sandy Stash, which addresses ARCO's indemnification of DEQ relating to your haul activities.

Mr. Eric Jacobsen
Page 3
March 10, 1997

DEQ understands that access arrangements with all Montana Pole property interests will be finalized early this week. The only outstanding issue appears to be the consummation of an agreement with ACCI regarding coordination, warranty protection, and indemnification. Bill Kirley and I will be calling ACCI later today to discuss ACCI's concerns further. Once an agreement with ACCI is in place, DEQ will be prepared to provide authorization to ARCO to commence construction of the haul road through the Montana Pole site.

Thank you for your proactive effort to identify and address all of the coordination and other technical issues that must be addressed to assure that both the LAO haul and MPTP operations can proceed without adverse impact on either project. As we proceed with these projects, don't hesitate to contact me if we need to consider other issues or revisit how we are addressing the issues identified in our correspondence.

Sincerely,

Neil Marsh

Neil Marsh, Project Manager

cc: Jim Harris, EPA
Joe Newton, CDM
Hunter Nolen, CDM
Randy Shepherd, ACCI
Ted Duaime, MBMG

DEPARTMENT OF ENVIRONMENTAL QUALITY

MARC RACICOT, GOVERNOR

STATE OF MONTANA

(406) 444-2544

PO BOX 200901
HELENA, MONTANA 59620-0901

March 10, 1997

Mr. Eric Jacobsen
ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

Dear Eric:

Subject: Excavation of Abandoned Railroad Berm on Montana Pole Site

The Department of Environmental Quality (DEQ) has completed its evaluation of the potential use of interior berm soils from the abandoned elevated railroad berm for backfill of the Montana Pole excavation. We have decided to utilize the berm soils for backfill. In consideration of our need for the interior berm materials for backfill and ARCO's need to excavate part of the berm for the Lower Area One/Clark Tailings haul road, we propose the following excavation scenario, which results in mutual benefits to both ARCO and DEQ.

ARCO will conduct the following activities:

1. Excavate and dispose of the visibly contaminated berm surface materials, which consist of stained and discolored residual ballast material, gravels, and possibly waste rock. All exploratory excavations and borings to date by DEQ indicate that the contaminated surface materials are limited to a depth of approximately 1 to 2 feet on the top of the berm and 1 foot on the side slopes. ARCO will excavate these materials for the entire length of the berm from its northern end to the point at which the active Montana Western rail line (Newcombe Branch) ascends and joins with the elevated berm alignment. The portion to be excavated is sketched on the attached map. ARCO may utilize the removed materials for ramp fill material on the Montana Pole site provided that it is underlain by geotextile fabric consistent with the design specified by ARCO in its March 5, 1997, LAO Phase 1, Segment II Work Plan/Final Design Report, Addendum 1. If ARCO chooses to stockpile the excavated surface materials at Montana Pole in order to expedite their removal and to facilitate subsequent DEQ removal of interior berm materials, ARCO may stockpile removed soils in the location of your proposed haul road immediately west of the Montana Pole retention pond for later transport to the Clark Tailings area. The entire stockpile area must be underlain by geotextile fabric to provide separation from pentachlorophenol contaminated Montana Pole soils in this location. ARCO may also stockpile excavated surface soils in the triangular area just east of the northern end of the berm if access for that purpose is provided by Montana Western Railroad. It will not be possible for ARCO to simply push the contaminated surface materials off the side of the

"AN EQUAL OPPORTUNITY EMPLOYER"

elevated berm for stockpiling at the berm toe because (1) DEQ needs to maintain use of its one north-site access road immediately west of the berm and (2) the rail line immediately east of the berm is in active use. ARCO may wait to remove the surface materials from the eastern portion of the elevated railroad grade until the end of its LAO/Clark Tailings haul operation, provided that DEQ does not need the underlying interior berm soils for backfill at this time. Any questions with respect to the extent of visibly impacted materials requiring removal will be discussed among ARCO, the oversight agencies, and their contractors. Final determinations about what must be removed will be made jointly by the LAO and Montana Pole agency personnel. DEQ has estimated the volume of surface materials to be excavated at 6,400 cubic yards, assuming that 2 feet are removed from the top and 1 foot from the sides of the berms.

2. Excavate and dispose of any timbers or other structural elements found in the berm. Wooden pilings (presumably to support a trestle to the north of the berm) are exposed at the northern end of the berm. One small concrete foundation (presumably for power pole support) is evident on top of the berm. The extent of buried structures is unknown, although DEQ did not encounter any while conducting borings during February. If DEQ's excavation of interior berm soils exposes a significant number of structural or nonsoil components or debris in the berm, we will stop excavation and consult with ARCO regarding the final grade elevation to be attained for the haul road.

3. Relocate the Montana Pole perimeter fence that is presently atop the berm. ARCO will remove the fence prior to commencing the surface materials excavation and store it in a location acceptable to Montana Western Railroad and DEQ. Immediately following or concurrent with the railroad berm excavations by ARCO and DEQ, ARCO will replace the fence to a location in its north-south aspect immediately east of the ARCO haul road and in its east-west aspect (east of the haul road and north of the Montana Pole land treatment unit) to the northern edge of the clean elevated berm, but not less that 13 feet south of the center line of the active Montana Western Newcombe Branch rail line. The fence must be in place before general hauling of the LAO tailings can begin.

4. When ARCO excavates impacted surface materials at the northern and eastern toe of the berm near the active Montana Western rail line, ARCO will scrape and remove the impacted materials up to the ties and ballast materials of the active line and will leave the surface contoured with a positive drainage swale away from the active line. This will be done in close consultation with personnel from Montana Western Railroad. ARCO can utilize clean materials from grade on the east side of its haul road to create its haul road berm, at the same time creating the positive drainage swale in this area.

5. Relocate the power line at the northern end of the berm consistent with the March 5, 1997, LAO Work Plan Addendum 1.

6. Remove all haul road elements at the completion of its LAO haul activities.

7. Disposal of all material removed by ARCO will be at the Old Butte Landfill/Clark Tailings area, as noted in our previous correspondence.

DEQ will conduct the following activities:

1. Excavate clean interior railroad bed materials for use as current backfill or stockpiled backfill at the Montana Pole site. DEQ will remove most of the elevated railroad grade in the location of the ARCO haul road, leaving adequate remaining material from which ARCO can construct haul road berms on the Montana Pole site. DEQ understands that it will be directed by the Montana Department of Transportation (MDOT) to leave some of the elevated grade in place near the piers of the interstate highway overpass. I expect to receive today MDOT's final specification for the allowable grade elevations near the highway piers. In the interest of expediting the construction of the haul road, DEQ will not excavate all of the interior materials from the berm to the east of the haul road at this time. Depending on the MDOT-specified grade elevation under the highway, we may have to excavate some of the eastern berm for backfill. DEQ has estimated that we will excavate approximately 25,000 cubic yards of interior berm materials and that it will require approximately 7 working days to excavate these soils.

2. DEQ will remove the power pole serving its air monitoring station near the east end of the elevated railroad berm to accommodate ARCO's removal of impacted surface materials. DEQ will replace the monitoring station in its present location when ARCO has completed its excavation in that area.

3. At the conclusion of ARCO haul activities, DEQ will relocate the perimeter fence, if necessary, to access the eastern portion of the elevated railroad berm to obtain additional backfill material for the Montana Pole site.

DEQ is convinced that the described activities can be performed by our respective contractors in a schedule that will satisfy the needs of both the ARCO LAO project and the DEQ Montana Pole project. We believe this approach provides significant benefits to both parties. Please let me know if the proposed approach to excavation of the haul road is acceptable to ARCO.

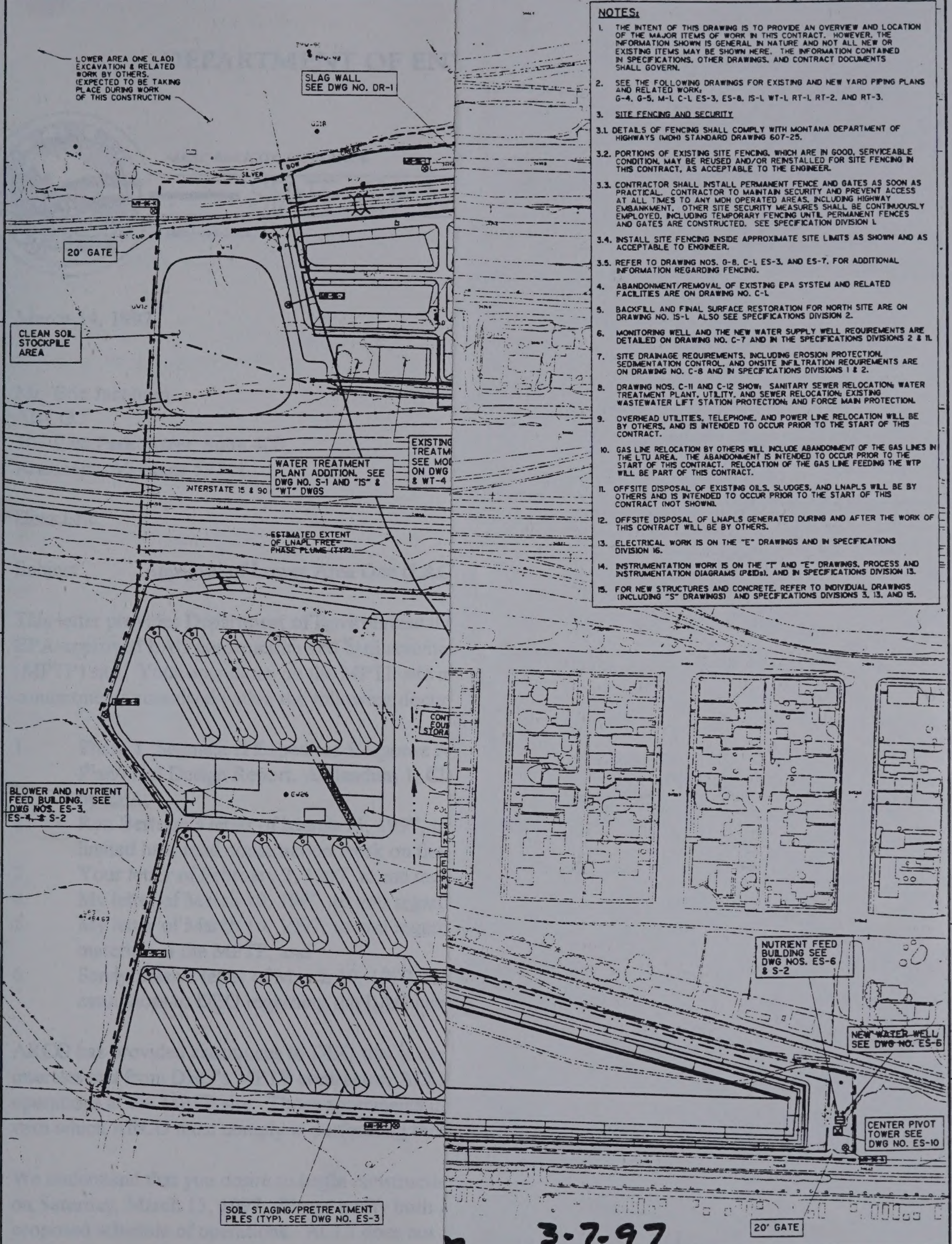
Sincerely,

Neil Marsh

Neil Marsh
Montana Pole Project Manager

Attachment (map)

cc: Hunter Nolen, CDM
Joe Newton, CDM
Randy Shepherd, ACCI
Jim Harris, EPA
Mark Etchart, BKB&H


LOWER AREA ONE (LAO) EXCAVATION & RELATED WORK BY OTHERS. (EXPECTED TO BE TAKING PLACE DURING WORK OF THIS CONSTRUCTION
SLAG WALL SEE DWG NO. DR-1
SILVER
BOW
CREEK
20' GATE
CLEAN SOIL STOCKPILE AREA
WATER TREATMENT PLANT ADDITION. SEE DWG NO. S-1 AND "IS" & "WT" DWGS
EXISTING TREATM SEE MOD ON DWG & WT-4
INTERSTATE 15 & 90
ESTIMATED EXTENT OF LNAPL FREE-PHASE PLUME (TYP)
CONT EQUI STORA
BLOWER AND NUTRIENT FEED BUILDING. SEE DWG NOS. ES-3, ES-4, & S-2
NUTRIENT FEED BUILDING SEE DWG NOS. ES-6 & S-2
NEW WATER WELL SEE DWG NO. ES-6
CENTER PIVOT TOWER SEE DWG NO. ES-10
SOIL STAGING/PRETREATMENT PILES (TYP). SEE DWG NO. ES-3
20' GATE

NOTES:

1. THE INTENT OF THIS DRAWING IS TO PROVIDE AN OVERVIEW AND LOCATION OF THE MAJOR ITEMS OF WORK IN THIS CONTRACT. HOWEVER, THE INFORMATION SHOWN IS GENERAL IN NATURE AND NOT ALL NEW OR EXISTING ITEMS MAY BE SHOWN HERE. THE INFORMATION CONTAINED IN SPECIFICATIONS, OTHER DRAWINGS, AND CONTRACT DOCUMENTS SHALL GOVERN.

2. SEE THE FOLLOWING DRAWINGS FOR EXISTING AND NEW YARD PIPING PLANS AND RELATED WORK:
G-4, G-5, M-1, C-1, ES-3, ES-8, IS-1, WT-1, RT-1, RT-2, AND RT-3.

3. SITE FENCING AND SECURITY

3.1. DETAILS OF FENCING SHALL COMPLY WITH MONTANA DEPARTMENT OF HIGHWAYS (MDH) STANDARD DRAWING 607-25.

3.2. PORTIONS OF EXISTING SITE FENCING, WHICH ARE IN GOOD, SERVICEABLE CONDITION, MAY BE REUSED AND/OR REINSTALLED FOR SITE FENCING IN THIS CONTRACT, AS ACCEPTABLE TO THE ENGINEER.

3.3. CONTRACTOR SHALL INSTALL PERMANENT FENCE AND GATES AS SOON AS PRACTICAL. CONTRACTOR TO MAINTAIN SECURITY AND PREVENT ACCESS AT ALL TIMES TO ANY MDH OPERATED AREAS, INCLUDING HIGHWAY EMBANKMENT. OTHER SITE SECURITY MEASURES SHALL BE CONTINUOUSLY EMPLOYED, INCLUDING TEMPORARY FENCING UNTIL PERMANENT FENCES AND GATES ARE CONSTRUCTED. SEE SPECIFICATION DIVISION 1.

3.4. INSTALL SITE FENCING INSIDE APPROXIMATE SITE LIMITS AS SHOWN AND AS ACCEPTABLE TO ENGINEER.

3.5. REFER TO DRAWING NOS. G-8, C-1, ES-3, AND ES-7, FOR ADDITIONAL INFORMATION REGARDING FENCING.

4. ABANDONMENT/REMOVAL OF EXISTING EPA SYSTEM AND RELATED FACILITIES ARE ON DRAWING NO. C-1.

5. BACKFILL AND FINAL SURFACE RESTORATION FOR NORTH SITE ARE ON DRAWING NO. IS-1. ALSO SEE SPECIFICATIONS DIVISION 2.

6. MONITORING WELL AND THE NEW WATER SUPPLY WELL REQUIREMENTS ARE DETAILED ON DRAWING NO. C-7 AND IN THE SPECIFICATIONS DIVISIONS 2 & 11.

7. SITE DRAINAGE REQUIREMENTS, INCLUDING EROSION PROTECTION, SEDIMENTATION CONTROL, AND ONSITE INFILTRATION REQUIREMENTS ARE ON DRAWING NO. C-8 AND IN SPECIFICATIONS DIVISIONS 1 & 2.

8. DRAWING NOS. C-11 AND C-12 SHOW: SANITARY SEWER RELOCATION; WATER TREATMENT PLANT, UTILITY, AND SEWER RELOCATION; EXISTING WASTEWATER LIFT STATION PROTECTION; AND FORCE MAIN PROTECTION.

9. OVERHEAD UTILITIES, TELEPHONE, AND POWER LINE RELOCATION WILL BE BY OTHERS, AND IS INTENDED TO OCCUR PRIOR TO THE START OF THIS CONTRACT.

10. GAS LINE RELOCATION BY OTHERS WILL INCLUDE ABANDONMENT OF THE GAS LINES IN THE LTU AREA. THE ABANDONMENT IS INTENDED TO OCCUR PRIOR TO THE START OF THIS CONTRACT. RELOCATION OF THE GAS LINE FEEDING THE WTP WILL BE PART OF THIS CONTRACT.

11. OFFSITE DISPOSAL OF EXISTING OILS, SLUDGES, AND LNAPLS WILL BE BY OTHERS AND IS INTENDED TO OCCUR PRIOR TO THE START OF THIS CONTRACT (NOT SHOWN).

12. OFFSITE DISPOSAL OF LNAPLS GENERATED DURING AND AFTER THE WORK OF THIS CONTRACT WILL BE BY OTHERS.

13. ELECTRICAL WORK IS ON THE "E" DRAWINGS AND IN SPECIFICATIONS DIVISION 16.

14. INSTRUMENTATION WORK IS ON THE "I" AND "E" DRAWINGS, PROCESS AND INSTRUMENTATION DIAGRAMS (P&IDs), AND IN SPECIFICATIONS DIVISION 13.

15. FOR NEW STRUCTURES AND CONCRETE, REFER TO INDIVIDUAL DRAWINGS (INCLUDING "S" DRAWINGS) AND SPECIFICATIONS DIVISIONS 3, 13, AND 15.

3-7-97

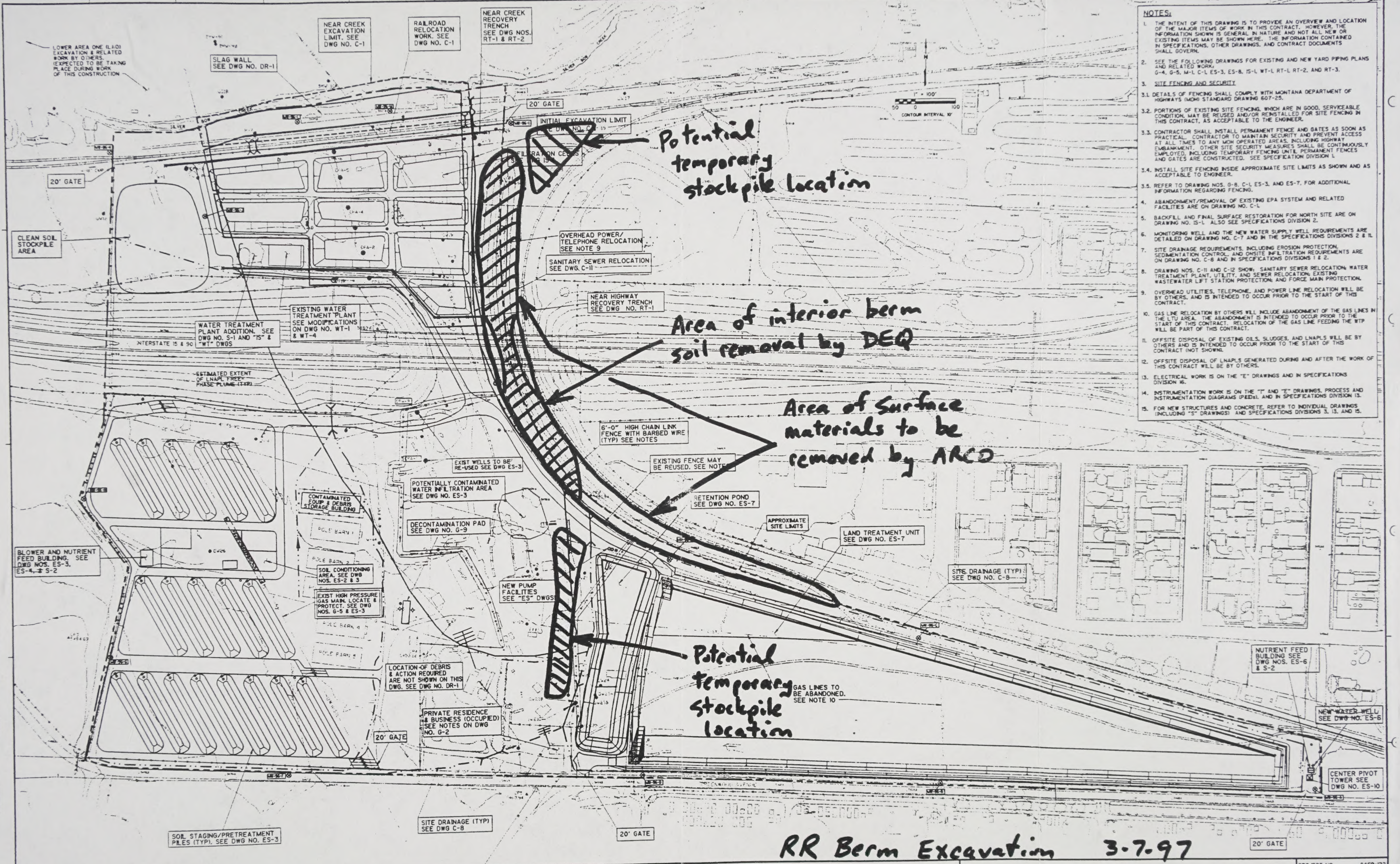
S:\8469 122\ 8469G-7 02/27/96 10:00:23 13:06:15 GORMAN J

REV. NO.	DATE	DRWN	CHKD	REMARKS

L SITE PLAN - WORK THIS CONTRACT

PROJECT NO. 8469-122
FILE NAME: 8469G-7

DRAWING NO.
G-7
8 OF 55


LOWER AREA ONE (LAO) EXCAVATION & RELATED WORK BY OTHERS. (EXPECTED TO BE TAKING PLACE DURING WORK OF THIS CONSTRUCTION
NEAR CREEK EXCAVATION LIMIT. SEE DWG NO. C-1
RAILROAD RELOCATION WORK. SEE DWG NO. C-1
NEAR CREEK RECOVERY TRENCH SEE DWG NOS. RT-1 & RT-2
SLAG WALL SEE DWG NO. DR-1
20' GATE
INITIAL EXCAVATION LIMIT SEE DWG NO. C-1
INFILTRATION CELLS
20' GATE
CLEAN SOIL STOCKPILE AREA
1" = 100'
50 0 100
CONTOUR INTERVAL 10'
OVERHEAD POWER/ TELEPHONE RELOCATION SEE NOTE 9
SANITARY SEWER RELOCATION SEE DWG. C-11
NEAR HIGHWAY RECOVERY TRENCH SEE DWG NO. RT-1
EXISTING WATER TREATMENT PLANT SEE MODIFICATIONS ON DWG NO. WT-1 & WT-4
WATER TREATMENT PLANT ADDITION. SEE DWG NO. S-1 AND "IS" & "WT" DWGS
INTERSTATE 15 & 90
ESTIMATED EXTENT OF LNAPL FREE-PHASE PLUME (TYP)
6'-0" HIGH CHAIN LINK FENCE WITH BARBED WIRE (TYP) SEE NOTES
EXISTING FENCE MAY BE REUSED. SEE NOTE
EXIST WELLS TO BE RE-USED SEE DWG ES-3
POTENTIALLY CONTAMINATED WATER INFILTRATION AREA SEE DWG NO. ES-3
CONTAMINATED EQUIP & DEBRIS STORAGE BUILDING
RETENTION POND SEE DWG NO. ES-7
APPROXIMATE SITE LIMITS
LAND TREATMENT UNIT SEE DWG NO. ES-7
DECONTAMINATION PAD SEE DWG NO. G-9
POLE BARN 1
POLE BARN 2
POLE BARN 4
POLE BARN 5
BLOWER AND NUTRIENT FEED BUILDING. SEE DWG NOS. ES-3, ES-4, & S-2
SOIL CONDITIONING AREA. SEE DWG NOS. ES-2 & 3
EXIST HIGH PRESSURE GAS MAIN. LOCATE & PROTECT. SEE DWG NOS. G-5 & ES-3
NEW PUMP FACILITIES SEE "ES" DWGS
SITE DRAINAGE (TYP) SEE DWG NO. C-8
LOCATION OF DEBRIS & ACTION REQUIRED ARE NOT SHOWN ON THIS DWG. SEE DWG NO. DR-1
PRIVATE RESIDENCE & BUSINESS (OCCUPIED) SEE NOTES ON DWG NO. G-2
GAS LINES TO BE ABANDONED. SEE NOTE 10
NUTRIENT FEED BUILDING SEE DWG NOS. ES-6 & S-2
NEW WATER WELL SEE DWG NO. ES-6
CENTER PIVOT TOWER SEE DWG NO. ES-10
20' GATE
SOIL STAGING/PRETREATMENT PILES (TYP). SEE DWG NO. ES-3
SITE DRAINAGE (TYP) SEE DWG C-8
20' GATE
20' GATE

Potential temporary stockpile location

Area of interior berm soil removal by DEQ

Area of Surface materials to be removed by ARCO

Potential temporary stockpile location

RR Berm Excavation 3-7-97

NOTES:

1. THE INTENT OF THIS DRAWING IS TO PROVIDE AN OVERVIEW AND LOCATION OF THE MAJOR ITEMS OF WORK IN THIS CONTRACT. HOWEVER, THE INFORMATION SHOWN IS GENERAL IN NATURE AND NOT ALL NEW OR EXISTING ITEMS MAY BE SHOWN HERE. THE INFORMATION CONTAINED IN SPECIFICATIONS, OTHER DRAWINGS, AND CONTRACT DOCUMENTS SHALL GOVERN.

2. SEE THE FOLLOWING DRAWINGS FOR EXISTING AND NEW YARD PIPING PLANS AND RELATED WORK:
G-4, G-5, M-1, C-1, ES-3, ES-8, IS-1, WT-1, RT-1, RT-2, AND RT-3.

3. SITE FENCING AND SECURITY

3.1 DETAILS OF FENCING SHALL COMPLY WITH MONTANA DEPARTMENT OF HIGHWAYS (MDH) STANDARD DRAWING 607-25.

3.2. PORTIONS OF EXISTING SITE FENCING, WHICH ARE IN GOOD, SERVICEABLE CONDITION, MAY BE REUSED AND/OR REINSTALLED FOR SITE FENCING IN THIS CONTRACT, AS ACCEPTABLE TO THE ENGINEER.

3.3. CONTRACTOR SHALL INSTALL PERMANENT FENCE AND GATES AS SOON AS PRACTICAL. CONTRACTOR TO MAINTAIN SECURITY AND PREVENT ACCESS AT ALL TIMES TO ANY MDH OPERATED AREAS, INCLUDING HIGHWAY EMBANKMENT. OTHER SITE SECURITY MEASURES SHALL BE CONTINUOUSLY EMPLOYED, INCLUDING TEMPORARY FENCING UNTIL PERMANENT FENCES AND GATES ARE CONSTRUCTED. SEE SPECIFICATION DIVISION 1.

3.4. INSTALL SITE FENCING INSIDE APPROXIMATE SITE LIMITS AS SHOWN AND AS ACCEPTABLE TO ENGINEER.

3.5. REFER TO DRAWING NOS. G-8, C-1, ES-3, AND ES-7, FOR ADDITIONAL INFORMATION REGARDING FENCING.

4. ABANDONMENT/REMOVAL OF EXISTING EPA SYSTEM AND RELATED FACILITIES ARE ON DRAWING NO. C-1.

5. BACKFILL AND FINAL SURFACE RESTORATION FOR NORTH SITE ARE ON DRAWING NO. IS-1. ALSO SEE SPECIFICATIONS DIVISION 2.

6. MONITORING WELL AND THE NEW WATER SUPPLY WELL REQUIREMENTS ARE DETAILED ON DRAWING NO. C-7 AND IN THE SPECIFICATIONS DIVISIONS 2 & 11.

7. SITE DRAINAGE REQUIREMENTS, INCLUDING EROSION PROTECTION, SEDIMENTATION CONTROL, AND ONSITE INFILTRATION REQUIREMENTS ARE ON DRAWING NO. C-8 AND IN SPECIFICATIONS DIVISIONS 1 & 2.

8. DRAWING NOS. C-11 AND C-12 SHOW: SANITARY SEWER RELOCATION; WATER TREATMENT PLANT, UTILITY, AND SEWER RELOCATION; EXISTING WASTEWATER LIFT STATION PROTECTION; AND FORCE MAIN PROTECTION.

9. OVERHEAD UTILITIES, TELEPHONE, AND POWER LINE RELOCATION WILL BE BY OTHERS, AND IS INTENDED TO OCCUR PRIOR TO THE START OF THIS CONTRACT.

10. GAS LINE RELOCATION BY OTHERS WILL INCLUDE ABANDONMENT OF THE GAS LINES IN THE LTU AREA. THE ABANDONMENT IS INTENDED TO OCCUR PRIOR TO THE START OF THIS CONTRACT. RELOCATION OF THE GAS LINE FEEDING THE WTP WILL BE PART OF THIS CONTRACT.

11. OFFSITE DISPOSAL OF EXISTING OILS, SLUDGES, AND LNAPLS WILL BE BY OTHERS AND IS INTENDED TO OCCUR PRIOR TO THE START OF THIS CONTRACT (NOT SHOWN).

12. OFFSITE DISPOSAL OF LNAPLS GENERATED DURING AND AFTER THE WORK OF THIS CONTRACT WILL BE BY OTHERS.

13. ELECTRICAL WORK IS ON THE "E" DRAWINGS AND IN SPECIFICATIONS DIVISION 16.

14. INSTRUMENTATION WORK IS ON THE "I" AND "E" DRAWINGS, PROCESS AND INSTRUMENTATION DIAGRAMS (P&IDs), AND IN SPECIFICATIONS DIVISION 13.

15. FOR NEW STRUCTURES AND CONCRETE, REFER TO INDIVIDUAL DRAWINGS (INCLUDING "S" DRAWINGS) AND SPECIFICATIONS DIVISIONS 3, 13, AND 15.

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: W. ABEL
DRAWN BY: K. CAMERON
SHEET CHK'D BY: BOD/EC
CROSS CHK'D BY: EC/BOD
APPROVED BY: H. NOLEN
DATE: FEBRUARY 1996

CAMP DRESSER & McKEE INC.
environmental engineers, scientists, planners, & management consultants
CDM

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
MONTANA POLE AND TREATING PLANT SITE REMEDIAL DESIGN

BUTTE, MONTANA

OVERALL SITE PLAN - WORK THIS CONTRACT

PROJECT NO. 8469-122
FILE NAME: 8469G-7

DRAWING NO.
G-7
8 OF 55

DEPARTMENT OF ENVIRONMENTAL QUALITY

MARC RACICOT, GOVERNOR

STATE OF MONTANA

(406) 444-2544

PO BOX 200901
HELENA, MONTANA 59620-0901

March 14, 1997

RECEIVED
MAR 18 1997
MONTANA FACILITIES

Mr. Eric Jacobsen
ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

Dear Eric:

Subject: Approval of Lower Area One (LAO) Haul Operation Across Montana Pole Site

This letter provides Department of Environmental Quality approval for ARCO to proceed with all EPA-approved LAO construction and haul activities on the Montana Pole and Treating Plant (MPTP) site. Your operations on the MPTP site must be consistent with the specifications and commitments contained within the following documents:

1. Phase 1, Segment II Expedited Response Action, Lower Area One Operable Unit, Work Plan/Final Design Report, Addendum 1, Clark Tailings Alternate Repository, as approved by EPA;
2. Ron Bertram's letter of March 11, 1997, to Chuck Stilwell providing EPA approval of limited haul road construction work on the MPTP site;
3. Your letter of February 3, 1997, to me regarding haul of LAO wastes through MPTP;
4. My letter of March 10, 1997, to you regarding haul of LAO wastes through MPTP;
5. My letter of March 10, 1997, to you regarding excavation of elevated railroad berm materials at the MPTP; and
6. Sandy Stash's letter of March 10, 1997, to Denise Mills providing indemnification and assurances to DEQ regarding the LAO haul operations.

ARCO has provided assurances to DEQ that it has procured agreements from all MPTP property interests and from DEQ's MPTP contractor, ACCI, providing full access to ARCO to conduct its operations at the MPTP site. Those agreements include additional conditions and requirements with which ARCO must comply in performing these activities.

We understand that you desire to begin constructing the haul road north of Greenwood Avenue on Saturday, March 15, 1997. Please notify both ACCI and our site engineer, CDM, of your proposed schedule of operations. ACCI does not plan on being on site on March 15, but will be in operation on Monday, March 17. Please make the necessary arrangements for conducting a

joint site safety meeting, to include all appropriate site management and operating personnel from all site contractors, prior to commencing activities on the site concurrently with our contractors' activities.

Thank you for your efforts in coordinating your project with ours. If you have any questions or concerns, don't hesitate to call me.

Sincerely,

Neil Marsh

Neil Marsh
Montana Pole Project Manager

cc: Hunter Nolen, CDM
Joe Newton, CDM
Randy Shepherd, ACCI
Ted Duaime, MBMG
Jim Harris, EPA
Ron Bertram, EPA
Mark Etchart, BKB&H

ATTACHMENT 2

Detailed Haul Road Work Plan and Design

CLARK TAILINGS
HAUL ROAD WORK PLAN

CONTRACTOR: Barnard Construction
OWNER: ARCO
DATE: 3/14/97

WORK ITEMS:

- **Coordination**
- **Build Haul Roads**
- **Protecting I-90 Columns, Railroad, Greenwood Avenue, & Beeftrail Road**
- **Run-on/Run-off Control**
- **Dust Control**
- **Haul Road Maintenance**
- **Traffic Control & Security**
- **Haul Road Restoration**

INTRODUCTION

Nearly one million cubic yards of tailings material from the LAO site will be transported along the haul road to the Clark Tailings disposal site.. This haul road will be built from the southern LAO border to the Clark Tailings. It will cross Silver Bow Creek, Montana Western Railroad, Montana Pole Treatment Plant (MPTP), Greenwood Avenue, Hollow / LaVelle property, and Beeftrail Road. This road will have almost constant heavy equipment traffic on it, primarily Cat 769C Trucks. Barnard will operate an 11-hour shift five to six days per week. To utilize maximum daylight, the shift timing will vary slightly throughout the year. A standard shift will be from 7:00 a.m. to 6:30 p.m. Barnard may choose to operate two shifts in the summer months of June, July, and August. Total shift time will be from 5:00 a.m. to 9:30 p.m.

COORDINATION

Barnard will coordinate work efforts with ARCO, MPC, ACCI, HolTran, MWRR, State of Montana, Superfund Program, and Butte-Silver Bow Public Works Department. Any changes to this plan will be coordinated with the appropriate parties

BUILD HAUL ROADS

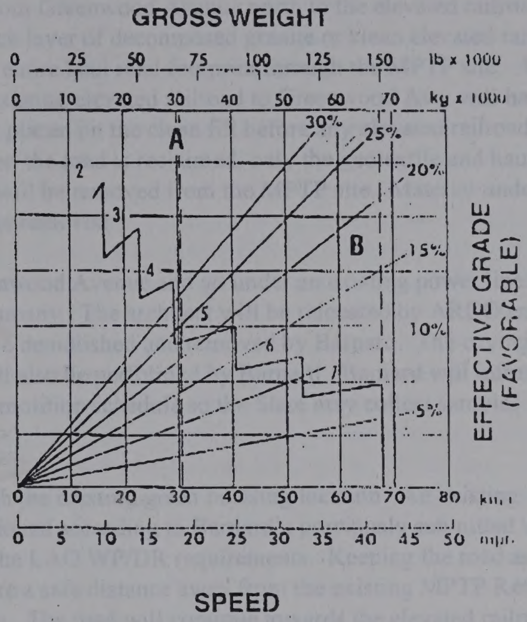
Attached is the plan view map (Map 1) and miscellaneous typical details and cross-sections (Figures 1 and 2) for the haul road from LAO south to Clark Tailings. The plan view map shows the haul road across existing railroad tracks, on the existing elevated railroad grade, through MPTP south of LAO, across Greenwood Avenue, through Hollow-LaVelle property, across Beeftrail Road and into the Clark Tailings.

The haul road will be built to the Haul Road Safety Policy Barnard implemented onsite in early September, 1996. This policy will be used as a guideline, but slight variations may need to be implemented to accommodate specific site features. These site features are the Silver Bow Creek crossing, railroad crossing, I-90 concrete bridge columns, MPTP site, Greenwood Avenue, and Beeftrail Road. Speed limits will be reduced as necessary to accommodate these features. Speed limit through the MPTP will be coordinated with ACCI and the State while construction activities are on-going at MPTP. The maximum speed limit will be increased to 35-MPH on straight-a-way stretches (such as between Greenwood Ave. and Beeftrail Rd.) where there are no impeding features. A 35-MPH truck speed and the truck brake performance at these speeds are within the safe limit running on a 2% or less grade for CAT 769C haul trucks according to the CAT handbook (See Table 1). These changes noted above as well as other possible changes will be re-verified and discussed once the haul road is built and prior to operation.

Haul Road from Beeftrail Road to Greenwood Avenue

A Cat D6H Dozer, Cat D8N Dozer, Cat 14G Blade, Cat Roller and a Water Truck will be used to construct the 60 feet wide haul road (outside berm to outside berm) between Beeftrail Road and Greenwood Avenue. All vegetation, trees, and shrubs will be removed and placed at the old Butte-Silverbow landfill. Existing topsoil will be stripped and either used to build berms that will run parallel with both sides of the road or stockpiled off to the side of the road, as directed by the landowner (Hollow). Barnard will build the road in a fashion that will allow any existing drainages or drainage structures to function equal to or better than they did prior to haul road construction. The road will be constructed to have a 50 feet wide driving surface. Any areas requiring fill to achieve this surface will be filled with nearby existing material.

Construction & Mining Trucks | 769C, 768C Brake Performance
Construction & Mining Tractors | • 900 m (3000 ft)



GRADE DISTANCE — 900 m (3000 ft)

KEY
2 — 2nd Gear
3 - - 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear
7 — 7th Gear

KEY
A* - - Empty 31 178 kg (68
B* - - Max GMW 67 586 kg

* [illegible]
[illegible]

Table 1. CAT 769C Brake Performance Table

Haul Road from Greenwood Avenue to LAO

Road Through MPTP

A Cat D6H Dozer, Cat D8N Dozer, Cat 14G Blade, Cat 769C Trucks, Cat Excavator, Cat Roller and a Water Truck will be used to build the 60 foot wide (outside berm to outside berm) haul road with berms from Greenwood Avenue north to the elevated railroad grade. A 4 inch minimum thick layer of decomposed granite or clean elevated rail grade material will be placed on the entire haul road footprint through the MPTP site. All areas of the haul road south of the existing elevated railroad to Greenwood Ave. will have geotextile fabric or equivalent placed on the clean fill before any elevated railroad, or other material, is placed. When the road is reclaimed, only the geotextile and haul road material above the geotextile will be removed from the MPTP site. Material underlying the geotextile fabric will not be removed.

The haul road will cross Greenwood Avenue and go under an existing power line to be raised by Montana Power Company. The architect will be relocated by ARCO and the green architect building will be demolished and removed by Barnard. The caving in and filling of an existing sump will also be performed by Barnard. Barnard will inform ARCO and the State of the demolition schedule so the State may collect samples at their discretion.

The road will continue through the existing green building location. An existing monitoring well will be abandoned according to Barnard's previously submitted well abandonment work plan and the LAO WP/DR requirements. Keeping the road as far to the west as possible will ensure a safe distance away from the existing MPTP Retention Pond and associated plumbing. The road will continue towards the elevated railroad staying to the east of some existing concrete structures. Any additional fill required in this area will come from the elevated railroad. From the north most concrete structure, the road will swing toward the west to line up with the existing north-south portion of the elevated railroad. The area between the concrete structures and the elevated railroad will be filled with clean material from the elevated railroad to achieve a gradual grade. This area will contain the low spot in the haul road through MPTP property. Barnard will build berms of existing clean railgrade material. Sufficient material will be placed over the utility corridor near the south end of the existing elevated grade to protect the utilities. Barnard will not disrupt any existing surface drainage. All equipment used for haul road construction at the MPTP will be decontaminated before leaving the site. After the road is built, any equipment passing through the site on the constructed haul road will not require decontamination procedures.

Orange safety fence or equivalent will be placed on both sides of the haul road through MPTP to prevent unauthorized or accidental entry onto the haul road. Access locations in the fence will be provided to allow MPTP equipment and personnel access to the MPTP treatment unit.

Figures 1 and 2 show details with respect to the haul road through the MPTP site.

Elevated Railroad

The elevated railroad will be excavated from the top down to establish a 45 foot minimum driving surface. At ARCO's direction, Barnard may remove the upper contaminated soil of the elevated grade and others will subsequently remove the clean elevated railgrade fill. After having a Cat D8N Dozer establish a ramp and road surface at the south end of the railroad, a Cat Excavator will be used to excavate the material and place it into trucks to be transported to Clark Tailings to be disposed of per the Technical Specifications. Berms will be left in place on both sides of the road for safety and to control runoff. Any material that falls outside the existing footprint of the elevated grade during haul road construction or hauling operations will be cleaned up and properly disposed of. Both ends of the elevated roadway will be excavated or graded to build a safe and effective haul road. The existing grade 10 feet of either side of the railroad tracks will be built up with decomposed granite material and slag to the same elevation as the railroad crossing. Existing topsoil will be striped off and replaced with compacted decomposed granite sub-base and approximately 12" of slag from the LAO site or an asphalt apron. The sub-base material will be compacted with a roller at optimum moisture content for adequate compaction. Geotextile fabric (AMOCO 4510) will be placed under the aprons and between the railroad ballast and the sub-base material to eliminate contamination to the ballast material with fines. The apron surface will be rolled to form a flat driveable surface. Slag is used as the base due to the angular slag faces providing competent support and the haul trucks will not track fines across and onto the crossing. The slag will be removed and returned to the LAO site for proper disposal once the crossing is no longer used. Once the railroad crossing is complete, the equipment needed for building the rest of the haul road will cross the railroad into the MPTP site and continue onto the entrance into the Clark Tailings.

Silver Bow Creek Crossing

One 72" CMP culvert will be installed at Silver Bow Creek to serve as a temporary crossing until all excavation is complete on the LAO site. Barnard will use LAO available material to backfill the culvert and construct the crossing. The crossing will have a minimum width of 50 feet, enabling 2 haul trucks to use the crossing at the same time.

PROTECTING I-90 COLUMNS, RAILROAD, GREENWOOD AVE. & BEEFTRAIL RD.

Earth berms will be placed along the haul road per the Haul Road Safety Plan. The berm on any elevated portion of the haul road will have a height equal to the axle height of the haul trucks. The berms near the I-90 concrete columns will be either 4 ft in height or have concrete Jersey barricades placed around them as was done on the haul road to the west borrow area.

The railroad crossing will be maintained by keeping both approaches stable and level with the top of the crossing. Barnard will mandate no turning, braking, or quick acceleration while on the crossing. The crossing will be cleaned on a daily basis or more frequently, if necessary, of any possible fine material dropping off the trucks and any other material that could impact the crossing or railroad. Any recurring structural maintenance of the railroad and crossing surface will be addressed between Barnard and Montana Western Railway.

Crossings at Greenwood Ave. and Beef Trail Rd. will be inspected weekly for construction damage. A temporary crossing surface will be installed at the public crossings to protect the paved surfaces of Greenwood Ave. and Beef Trail Rd. When weather permits, the crossings will be structurally reinforced with a hot mix of asphalt. If construction traffic damages the paved surfaces of Greenwood Ave and/or Beef Trail Rd. enough to impede public use, as determined by ARCO, the damage will be repaired by Barnard by steel sheets, repaving, or adding a controlled density fill material (i.e. concrete). Haul road approaches to the public crossings will be covered with coarse gravel 100 feet on both sides of the crossings.

RUN-ON/RUN-OFF CONTROL

Earth berms will be placed along the haul road per the Haul Road Safety Plan. The function of the berms is primarily for safety but also to capture contact water within the berms and prevent any run-on from the surrounding area to enter the haul road. Berms, sediment control structures, and culverts will be maintained and cleaned to ensure they can pass run-on/run-off loads.

Beef Trail Rd to Greenwood Ave.

It may be necessary to build small sediment control structures outside of the haul road right of way to contain excess amounts of surface run-on captured within the berms. This excess run-on will pool in low areas of the haul road and can be diverted from the haul road to a sediment control structure using a small culvert or a piece of pipe. The purpose of the sediment control structure is to capture any sediments or LAO material spilled onto the haul road. These sediment control structures will be removed when the haul road is restored and cleaned of sediment as required. Removed sediment will be placed and compacted at Clark Tailings. Ditches and culverts will be installed as needed to maintain proper drainage from surrounding areas. The haul road through Hollow property will be graded to 1% sloping toward Greenwood Ave. either during construction or during haul road restoration. The drainage from the haul road on Hollow property and from the southwest sector of the haul road/Greenwood Ave. intersection will be controlled by

installing a 36" HDPE culvert south of Greenwood Ave. under the haul road where runoff will be carried under Greenwood via the existing culvert and into the MPTP drainage system.

Greenwood Ave. to LAO

Barnard will build a small hump in the road north of Greenwood Ave. to inhibit run-on from Greenwood to the haul road on the MPTP site.

Near the green building location, Barnard will install a 12" or 24" culvert under the haul road to the existing 24" HDPE storm water cleanout and a catch basin on the west side of the haul road per ARCO and State directions.

From the north most concrete structures (~STA 7+00 - 8+00, Figure 1) the haul road swings west to line up with the north-south portion of the elevated railroad. Fill required to bring the haul road up to the elevated rail grade will be placed in a low spot of the MPTP site. An existing 24" HDPE storm drain will be extended, with steel or corrugated metal pipe, a minimum of 5 feet beyond any fill placed in that area. Fill placed over the storm drain and MPTP utility corridor will be of sufficient thickness or structural integrity to not damage the drain or any utilities.

Barnard will install a 12" diameter poly culvert through the west side haul road berm to drain any water collected on the haul road. This water will drain into an existing MPTP infiltration area west of the haul road. Run-off from the northern portion of the haul road (near RR tracks) will be diverted to the northeast so as not to drain directly into the old Silver Bow Creek channel.

DUST CONTROL

Barnard will control visible dust on the haul road using a water truck and by applying dust abatement chemicals such as magnesium chloride and/or calcium chloride. The haul road will be constantly monitored for visible dust by all personnel. A standby water truck and driver will be available during off-hours to control dust as needed. Members of the public may call ARCO or Barnard representatives to initiate off-hour dust control. Names and numbers of ARCO and Barnard personnel will be posted at the Clark Tailings site and listed in media releases.

If air monitoring results show dust or metals from Barnard's operations are exceeding ambient air quality standards, additional water trucks will be used and/or surfactants or chemicals will be applied more generously.

HAUL ROAD MAINTENANCE

The unpaved sections of the haul road will be maintained as needed. Maintenance will be performed with a Cat 14G Blade. The haul road will be inspected daily by supervisory

personnel. Haul truck drivers will notify Barnard supervisory personnel of any spillage of LAO excavated materials. Barnard supervisory personnel will dispatch clean-up equipment (front end loader) to clean up the spilled LAO excavated material for disposal at Clark Tailings as needed. Paved public approaches to the haul road crossings will be maintained and cleaned, specifically during the winter months when sanding of icy roads may be required.

TRAFFIC CONTROL & HAUL ROAD SECURITY

At the railroad crossing, Barnard's current plan is to use a part time security guard or stop signs initially, and then eliminate the flagman when signalized crossings are installed. Barnard will also have Montana Western's train dispatcher call and alert us of the approximate time when the next train will be passing across our haul road (usually within 15 minutes). Barnard truck drivers, equipment operators, and site personnel will also be notified. The process used will be similar to that implemented successfully during the 1996 construction at the west end of the Lao site.

In addition to signage, two full time flagmen (at each intersection) at Greenwood Ave. and Beef Trail Rd.will direct construction and public traffic and keep the public from inadvertently accessing the haul road.

Flagmen at Public Crossings

Two full-time Flagmen will be used at each public street crossing. These individuals will perform two functions: 1) Direct construction and public traffic safely across the haul road; 2) Secure public traffic from entering the Montana Pole Treatment Site, Clark Tailings disposal site, or haul road between Greenwood and Beef Trail Roads.

Construction traffic will be directed by fixed/handheld signage and by radio communication between the Flagmen at each crossing and the haul truck drivers. Public traffic will be directed by fixed/handheld signage. One flagman will be the leader at each crossing to avoid sending confusing signals to the public or equipment operators. The physical presence of Security flagmen during active hauling periods and the closing of gates during off-hours will provide security of the haul road from public traffic.

Flagmen will keep a daily log/checklist to ensure proper signage, equipment, and procedures are in-place and maintained during the course of construction activities. Flagmen will be receive training in accordance with standard operating procedures provided by the Montana Department of Transportation.

In order to ensure the safety of the public where Barnard Construction Company, Inc.'s (BCCI) Haul Road crosses Greenwood Road and Beef Trail Road, the following traffic control plan will be implemented.

Traffic Signs and Lights

Four "STOP" signs with flashing red lights on top of the signs will be posted, two on each side of the street crossing, 25 ft. away from the Haul Road and facing public traffic.

"STOP AHEAD" signs and "FLAGMAN AHEAD" signs will be posted on each side of the street crossing, 500 ft. away from the Haul Road, facing public traffic. Haul trucks are expected to reach these street crossings once every 1.5 minutes. If Barnard chooses to haul backfill back to the LAO site, haul truck crossings may be even more frequent. The Flagmen will hold a two sided "STOP" sign.

Crossing Procedure

All public traffic will stop momentarily, or longer if dictated by haul traffic, at the Haul Road/Public Street intersections. After public vehicles have stopped, they will be directed by a Flagman to either proceed or wait at the "STOP" signs. The Flagman will direct public traffic through the intersection if there are no Haul Trucks at or inside the "timing markers", which are simply visual markers (e.g. fluorescent or bright posts) placed along the Haul Road that serve as a visual signal to the Flagman. The Flagman will hold public traffic at the "STOP" signs using the two sided "STOP" sign, if there are Haul Trucks at or inside the "timing markers". If haul trucks enter the "timing marker" zone when the public is crossing, the next public vehicle will be stopped on both sides and requested to wait until the haul truck passes.

Additional Safety Measures

The "timing markers" are placed along the Haul Road, approximately 1000 ft. from the street crossing. The Haul Trucks will take 20 seconds to reach the crossing from the "timing markers", traveling at a maximum speed limit of 30 mph. This time delay from when the haul truck is at the "timing marker" until it reaches the crossing has a safety factor of two, and will ensure that public traffic and Haul Trucks do not meet at the street crossings.

Haul Truck Operators will receive training on Barnard's Haul Road Safety Policy and the site specific Health and Safety Plan. Haul Truck Operators will look both ways before crossing public streets. Haul Trucks will use their headlights at all time. Equipment operators will have 2-way radios to communicate hazards or potential hazards. The flagmen will have radio communication with Haul Truck Operators, Water Truck Drivers, and Supervisory Personnel. The flagmen will stop all haul traffic in a public emergency and radio Barnard's base. Flagmen will wear fluorescent orange vests, hard hats and safety glasses. Flagmen will clean public crossings on a daily basis, or as otherwise required, of fine material that may fall from the trucks. Flagmen will not take breaks simultaneously. A flagman on break will be temporarily relieved by a foreman, supervisor, or other qualified personnel. Each public crossing will be manned by two flagmen during active hauling periods. Construction foremen and site supervisors will check on the flagmen regularly during the day and will provide them with breaks as needed

Members of the public who display deliberate disregard for the in-place signage and/or flagmen will be recorded in the daily log/checklist. Barnard shall take appropriate steps (i.e., notifying authorities) if required.

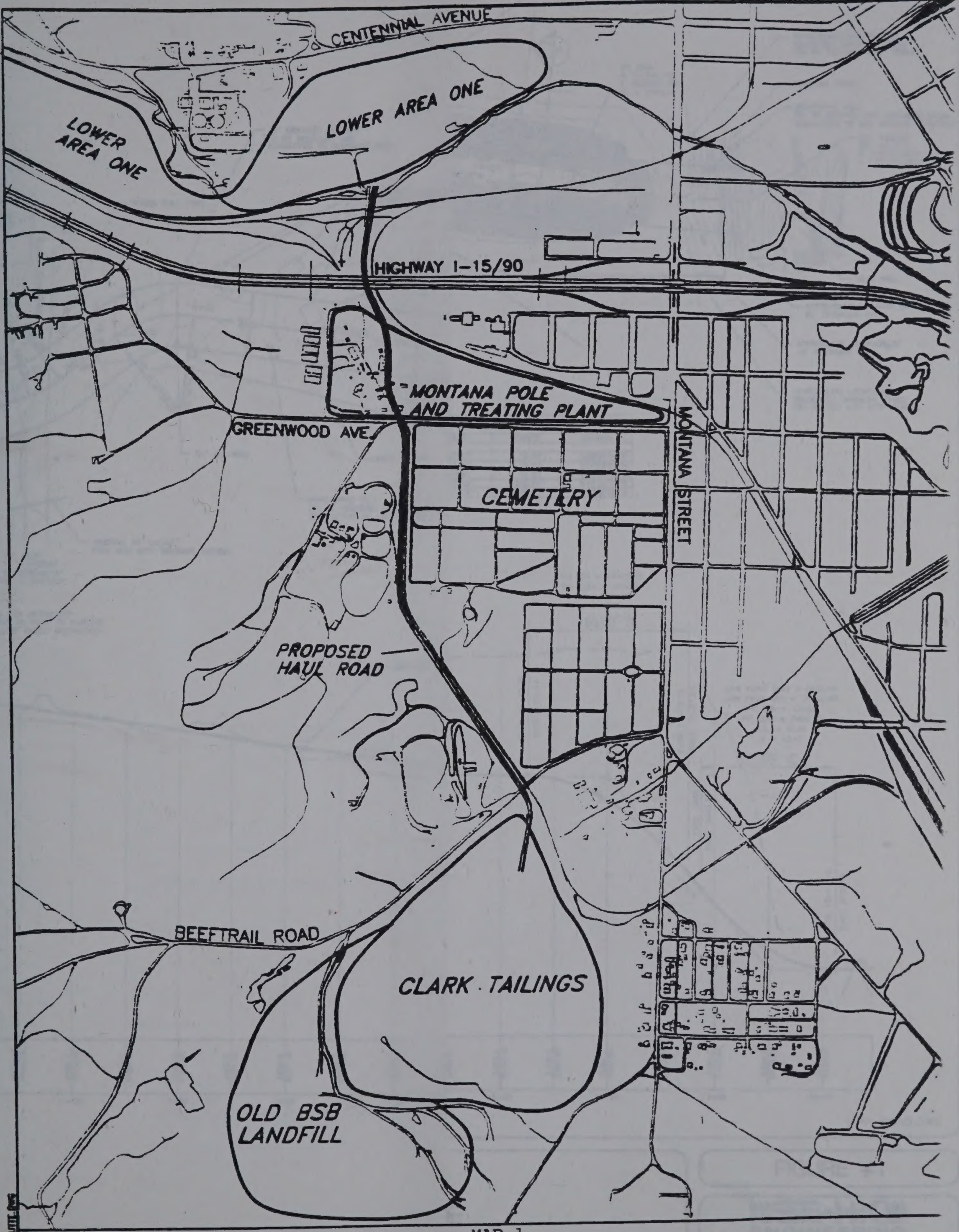
Haul Road Security

Barnard recognizes security needs to be maintained during construction. Barnard will install a gate constructed of existing like materials used to fence Clark Tailing CWMA. Two six foot tall chain link gates (like materials to existing MPTP fence) will be installed at the MPTP boundary near Greenwood Avenue. These gates will be closed by the flagmen during breaks and off duty hours. Barnard will relocate the existing chain link fence on the elevated railroad grade to no closer than 12.5 feet west from centerline of the existing railroad tracks. Barnard will also install two 25 foot swinging chain link gates just south of the railroad crossing. Other cable and steel post type gates will be installed on the light truck access roads and the jeep trails along the haul road. Obstructions such as steep berm, boulders or other obstructions will be installed to prevent anyone from trying to travel around these gates. Signs will be properly posted in well seen places. Orange safety fence will be installed in areas that could create fall hazards, areas of unstable ground, or others areas that have potential to harm people or animals.

HAUL ROAD RESTORATION

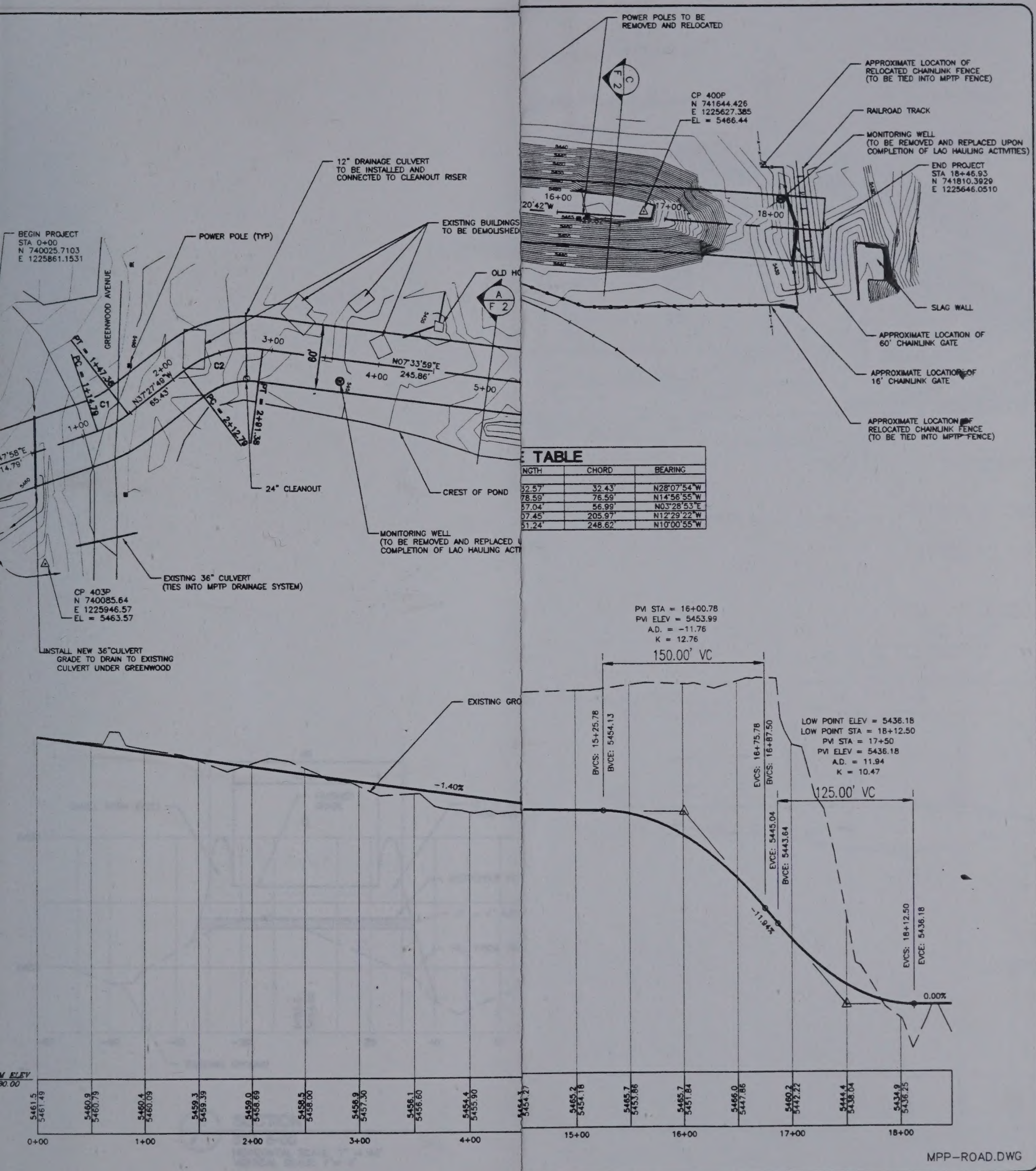
Any spillage of LAO excavated materials will be cleaned up and properly disposed of at Clark Tailings. Dirt sections of the road will be graded, and backfilled as necessary to contours as existed prior to road construction. Fences, gates, and other features installed by Barnard will be removed as directed by ARCO. The hail road through MPTP will be removed to the geotextile fabric. The elevated railroad will have the safety berms bladed away from the edge and spread over the top of the railroad. Remaining haul road surfaces will be graded and scarified in preparation for revegetation by other ARCO contractors unless otherwise agreed by the landowner. All damage to streets, signs, etc. at the two public crossings will be repaired or replaced. Upon completion of hauling to Clark Tailings, Barnard will replace the damaged, paved surfaces of Greenwood Ave. and Beef Trail Rd. Barnard will coordinate all paving with the Butte-Silver Bow Public Works Department.

A new monitoring well will be installed on the MPTP site. This well will be installed according to the specifications provided by the Montana Bureau of Mines and Geology.


CENTENNIAL AVENUE
LOWER AREA ONE
LOWER AREA ONE
HIGHWAY I-15/90
MONTANA POLE AND TREATING PLANT
GREENWOOD AVE.
MONTANA STREET
CEMETERY
PROPOSED HAUL ROAD
BEEFTRAIL ROAD
CLARK TAILINGS
OLD BSB LANDFILL
C:/BUTTE95/BUTTE.DWG

MAP 1

PROPOSED HAUL ROAD: LAO TO CLARK TAILINGS


POWER POLES TO BE REMOVED AND RELOCATED
APPROXIMATE LOCATION OF RELOCATED CHAINLINK FENCE (TO BE TIED INTO MPTP FENCE)
CP 400P
N 741644.426
E 1225627.385
EL = 5466.44
RAILROAD TRACK
MONITORING WELL (TO BE REMOVED AND REPLACED UPON COMPLETION OF LAO HAULING ACTIVITIES)
END PROJECT
STA 18+46.93
N 741810.3929
E 1225646.0510
C
F 2
16+00
17+00
18+00
20'42"W
SLAG WALL
APPROXIMATE LOCATION OF 60' CHAINLINK GATE
APPROXIMATE LOCATION OF 16' CHAINLINK GATE
APPROXIMATE LOCATION OF RELOCATED CHAINLINK FENCE (TO BE TIED INTO MPTP FENCE)
12" DRAINAGE CULVERT TO BE INSTALLED AND CONNECTED TO CLEANOUT RISER
EXISTING BUILDINGS TO BE DEMOLISHED
BEGIN PROJECT
STA 0+00
N 740025.7103
E 1225861.1531
POWER POLE (TYP)
OLD HO
A
F 2
GREENWOOD AVENUE
PT = 1+47.38
PC = 1+14.79
C1
C2
1+00
2+00
3+00
4+00
5+00
N37°27'49"W
65.43'
PC = 2+12.79
PT = 2+81.38
60'
N07°33'59"E
245.86'
7'58"E
14.79'
24" CLEANOUT
CREST OF POND
MONITORING WELL (TO BE REMOVED AND REPLACED U COMPLETION OF LAO HAULING ACTI
EXISTING 36" CULVERT (TIES INTO MPTP DRAINAGE SYSTEM)
CP 403P
N 740085.64
E 1225946.57
EL = 5463.57
INSTALL NEW 36"CULVERT GRADE TO DRAIN TO EXISTING CULVERT UNDER GREENWOOD
PVI STA = 16+00.78
PVI ELEV = 5453.99
A.D. = -11.76
K = 12.76
150.00' VC
EXISTING GRO
BVCS: 15+25.78
BVCE: 5454.13
EVCS: 16+75.78
BVCS: 16+87.50
EVCE: 5445.04
BVCE: 5443.64
LOW POINT ELEV = 5436.18
LOW POINT STA = 18+12.50
PVI STA = 17+50
PVI ELEV = 5436.18
A.D. = 11.94
K = 10.47
125.00' VC
-1.40%
-11.94%
EVCS: 18+12.50
EVCE: 5436.18
0.00%
M ELEV
90.00
5461.5
5461.49
5460.9
5460.79
5460.4
5460.09
5459.3
5459.39
5459.0
5458.69
5458.5
5458.00
5456.9
5457.30
5456.1
5456.60
5454.4
5455.90
5454.3
5454.27
5465.2
5454.18
5465.7
5453.86
5465.7
5451.84
5466.0
5447.86
5460.2
5442.22
5444.4
5438.04
5434.9
5436.25
0+00
1+00
2+00
3+00
4+00
15+00
16+00
17+00
18+00

E TABLE

NGTH	CHORD	BEARING
32.57'	32.43'	N28°07'54"W
78.59'	76.59'	N14°56'55"W
57.04'	56.99'	N03°28'53"E
07.45'	205.97'	N12°29'22"W
51.24'	248.62'	N10°00'55"W

MPP-ROAD.DWG

E
P SITE

FIGURE #1

MSE-HKM
ENGINEERING

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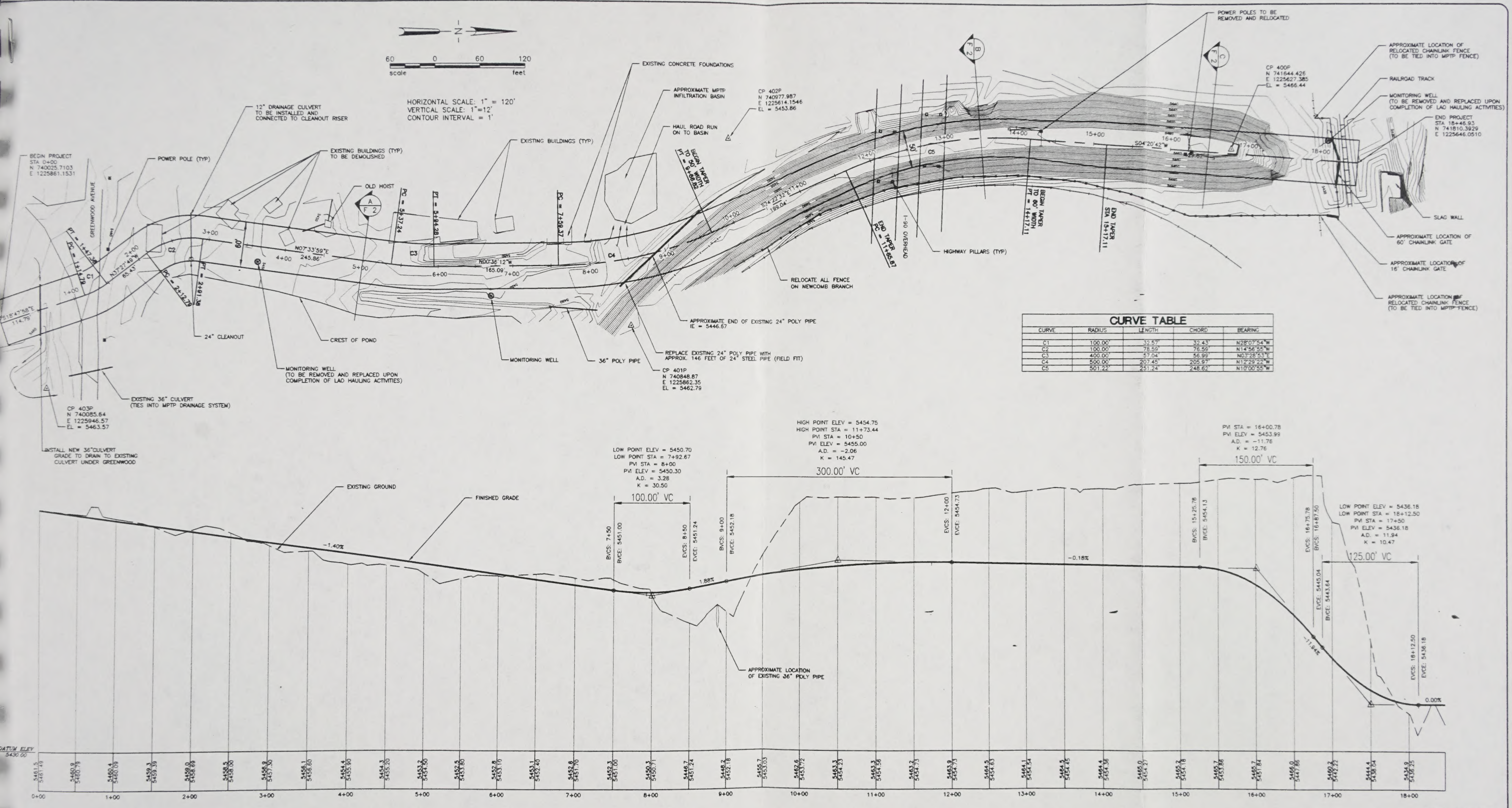
N
60 0 60 120
scale feet
HORIZONTAL SCALE: 1" = 120'
VERTICAL SCALE: 1"=12'
CONTOUR INTERVAL = 1'
BEGIN PROJECT
STA 0+00
N 740025.7103
E 1225861.1531
GREENWOOD AVENUE
POWER POLE (TYP)
12" DRAINAGE CULVERT TO BE INSTALLED AND CONNECTED TO CLEANOUT RISER
EXISTING BUILDINGS (TYP) TO BE DEMOLISHED
OLD HOIST
A F 2
PT = 1+47.36
PC = 1+14.79
C1
C2
C3
C4
C5
S18°47'58"E 114.79'
N37°27'49"W 65.43'
PC = 2+12.79
PT = 2+91.38
60'
N07°33'59"E 245.86'
PC = 5+37.24
PT = 5+94.28
N00°36'12"W 165.09'
PC = 7+59.37
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
24" CLEANOUT
CREST OF POND
MONITORING WELL (TO BE REMOVED AND REPLACED UPON COMPLETION OF LAO HAULING ACTIVITIES)
EXISTING 36" CULVERT (TIES INTO MPTP DRAINAGE SYSTEM)
CP 403P
N 740085.64
E 1225946.57
EL = 5463.57
INSTALL NEW 36"CULVERT GRADE TO DRAIN TO EXISTING CULVERT UNDER GREENWOOD
EXISTING BUILDINGS (TYP)
EXISTING CONCRETE FOUNDATIONS
APPROXIMATE MPTP INFILTRATION BASIN
HAUL ROAD RUN ON TO BASIN
CP 402P
N 740977.987
E 1225614.1546
EL = 5453.86
BEGIN TAPER TO 50' WIDTH PT = 9+66.82
S24°22'32"E 199.04'
MONITORING WELL
36" POLY PIPE
APPROXIMATE END OF EXISTING 24" POLY PIPE IE = 5446.67
REPLACE EXISTING 24" POLY PIPE WITH APPROX. 146 FEET OF 24" STEEL PIPE (FIELD FIT)
CP 401P
N 740848.87
E 1225862.35
EL = 5462.79
RELOCATE ALL FENCE ON NEWCOMB BRANCH
B F 2
50'
END TAPER PC = 11+65.87
I-90 OVERHEAD
HIGHWAY PILLARS (TYP)
BEGIN TAPER TO 60' WIDTH PT = 14+17.11
END TAPER STA 15+17.11
POWER POLES TO BE REMOVED AND RELOCATED
C F 2
S04°20'42"W
CP 400P
N 741644.426
E 1225627.385
EL = 5466.44
APPROXIMATE LOCATION OF RELOCATED CHAINLINK FENCE (TO BE TIED INTO MPTP FENCE)
RAILROAD TRACK
MONITORING WELL (TO BE REMOVED AND REPLACED UPON COMPLETION OF LAO HAULING ACTIVITIES)
END PROJECT
STA 18+46.93
N 741810.3929
E 1225646.0510
SLAG WALL
APPROXIMATE LOCATION OF 60' CHAINLINK GATE
APPROXIMATE LOCATION OF 16' CHAINLINK GATE
APPROXIMATE LOCATION OF RELOCATED CHAINLINK FENCE (TO BE TIED INTO MPTP FENCE)
EXISTING GROUND
FINISHED GRADE
-1.40%
LOW POINT ELEV = 5450.70
LOW POINT STA = 7+92.67
PVI STA = 8+00
PVI ELEV = 5450.30
A.D. = 3.28
K = 30.50
100.00' VC
BVCS: 7+50
BVCE: 5451.00
EVCS: 8+50
EVCE: 5451.24
1.88%
BVCS: 9+00
BVCE: 5452.18
HIGH POINT ELEV = 5454.75
HIGH POINT STA = 11+73.44
PVI STA = 10+50
PVI ELEV = 5455.00
A.D. = -2.06
K = 145.47
300.00' VC
EVCS: 12+00
EVCE: 5454.73
-0.18%
APPROXIMATE LOCATION OF EXISTING 36" POLY PIPE
PVI STA = 16+00.78
PVI ELEV = 5453.99
A.D. = -11.76
K = 12.76
150.00' VC
BVCS: 15+25.78
BVCE: 5454.13
EVCS: 16+75.78
BVCS: 16+87.50
EVCE: 5445.04
BVCE: 5443.64
-11.94%
LOW POINT ELEV = 5436.18
LOW POINT STA = 18+12.50
PVI STA = 17+50
PVI ELEV = 5436.18
A.D. = 11.94
K = 10.47
125.00' VC
EVCS: 18+12.50
EVCE: 5436.18
0.00%
DATUM ELEV 5430.00
5461.5 5461.49
5460.9 5460.79
5460.4 5460.09
5459.3 5459.39
5459.0 5458.69
5458.5 5458.00
5458.9 5457.30
5456.1 5456.60
5454.4 5455.90
5454.3 5455.20
5453.2 5454.50
5452.5 5453.80
5452.8 5453.10
5453.1 5452.40
5452.8 5451.70
5452.3 5451.00
5450.3 5450.71
5446.7 5451.24
5448.2 5452.18
5455.7 5453.03
5462.6 5453.72
5463.3 5454.23
5463.3 5454.56
5463.2 5454.73
5463.9 5454.73
5464.5 5454.63
5464.1 5454.54
5464.5 5454.45
5464.4 5454.36
5465.0 5454.27
5465.2 5454.18
5465.7 5453.88
5465.7 5451.84
5466.0 5447.86
5460.2 5442.22
5444.4 5438.04
5434.9 5436.25
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00

CURVE TABLE

CURVE	RADIUS	LENGTH	CHORD	BEARING
C1	100.00'	32.57'	32.43'	N28°07'54"W
C2	100.00'	78.59'	76.59'	N14°56'55"W
C3	400.00'	57.04'	56.99'	N03°28'53"E
C4	500.00'	207.45'	205.97'	N12°29'22"W
C5	501.22'	251.24'	248.62'	N10°00'55"W

MPP-ROAD.DWG

LOWER AREA ONE
PLAN AND PROFILE
HAUL ROAD THRU MPTP SITE

FIGURE #1

MSE-HKM
ENGINEERING

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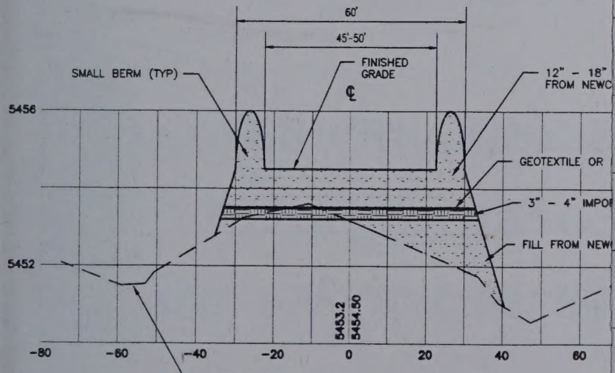
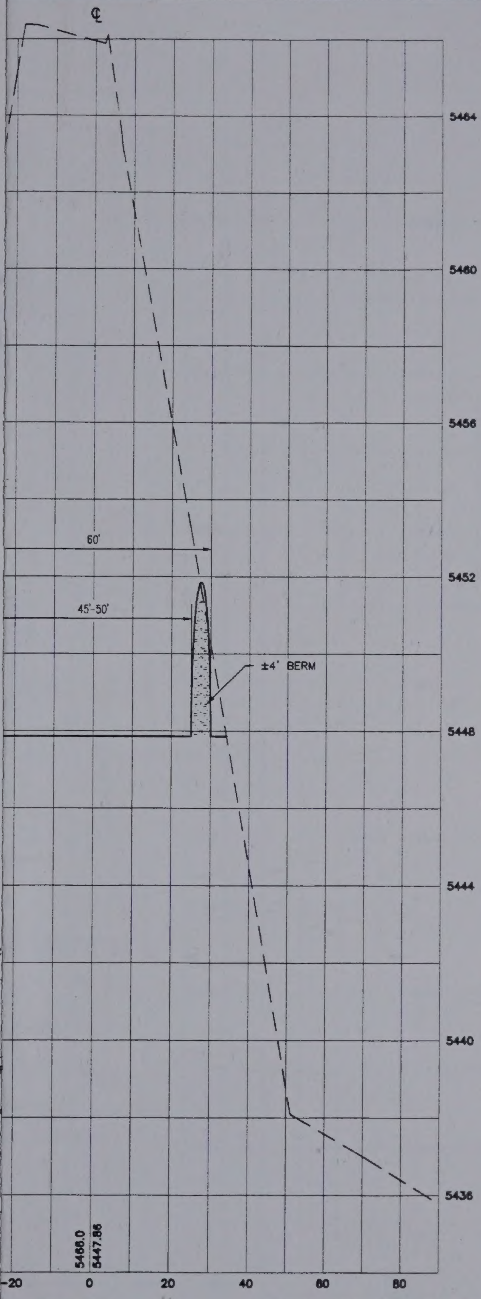

60'
45'-50'
SMALL BERM (TYP)
FINISHED GRADE
℄
12" - 18"
FROM NEWC
GEOTEXTILE OR
3" - 4" IMPOR
FILL FROM NEW
5456
5452
5453.2
5454.50
-80
-60
-40
-20
0
20
40
60
EXISTING GROUND

A / F 1 **SECTION**

STA 5+00
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 0+00 TO STA 9+33


℄
5464
5460
5456
5452
5448
5444
5440
5436
60'
45'-50'
±4' BERM
5466.0
5447.88
-20
0
20
40
60
80

SECTION

STA 16+50
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 9+33 TO STA 9+66.82 &
FROM STA 15+17.11 TO STA 18+46.93

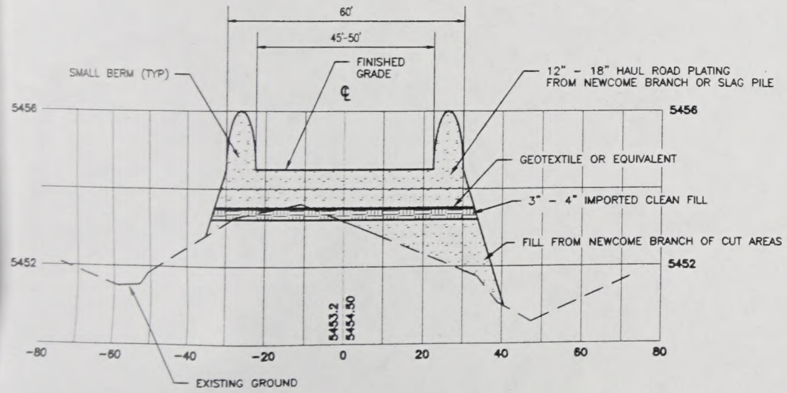
TYPSECTS.DWG

P SITE

FIGURE #2

MSE-HKM
ENGINEERING

15B455.108	2/97

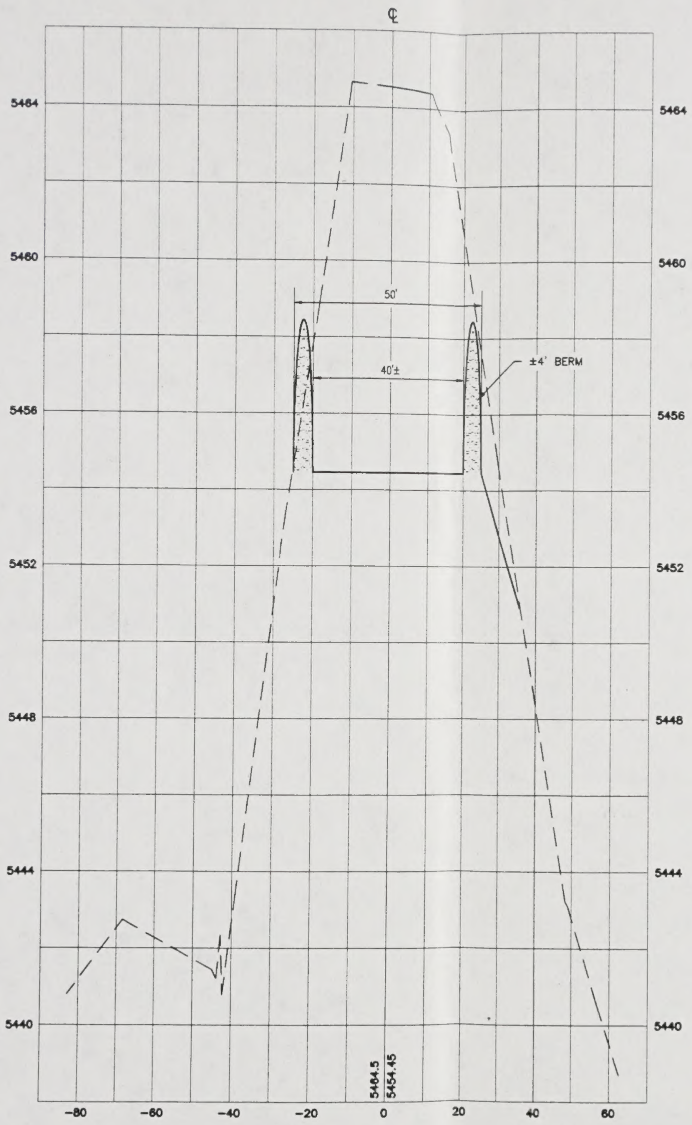

60'
45'-50'
SMALL BERM (TYP)
FINISHED GRADE
℄
12" - 18" HAUL ROAD PLATING FROM NEWCOME BRANCH OR SLAG PILE
GEOTEXTILE OR EQUIVALENT
3" - 4" IMPORTED CLEAN FILL
FILL FROM NEWCOME BRANCH OF CUT AREAS
EXISTING GROUND
5456
5452
5453.2
5454.50
-80
-60
-40
-20
0
20
40
60
80

(A/F 1) SECTION

STA 5+00

HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 0+00 TO STA 9+33


℄
50'
40'±
±4' BERM
5464
5460
5456
5452
5448
5444
5440
5464.5
5454.45
-80
-60
-40
-20
0
20
40
60

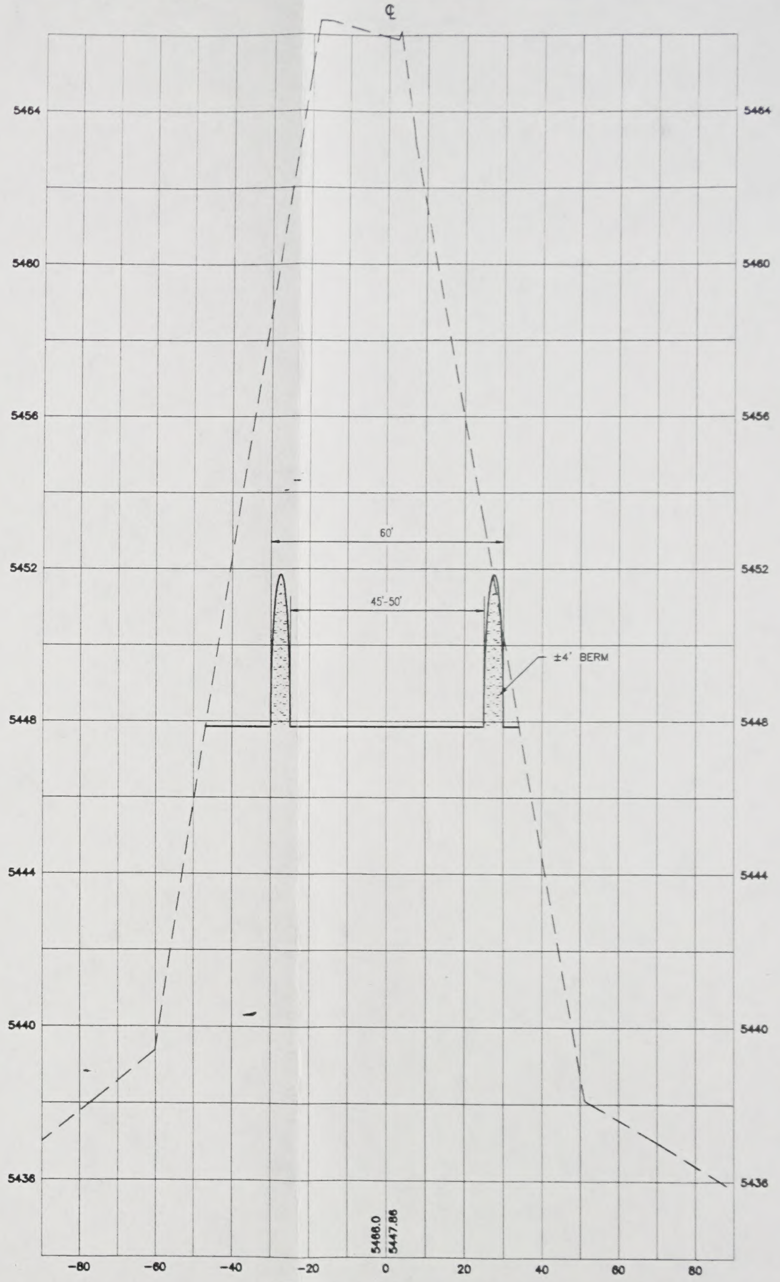
(B/F 1) SECTION

STA 13+50

HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 11+65.87 TO STA 14+17.11

TYPICAL SECTION TAPERS FROM 60' TO 50' FROM STA 9+66.82 TO STA 11+65.87
TYPICAL SECTION TAPERS FROM 50' TO 60' FROM STA 14+17.11 TO STA 15+17.11


℄
60'
45'-50'
±4' BERM
5464
5460
5456
5452
5448
5444
5440
5436
5466.0
5447.86
-80
-60
-40
-20
0
20
40
60
80

(C/F 1) SECTION

STA 16+50

HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1"= 4'

FINISHED GRADE SECTION IS TYPICAL
FROM STA 9+33 TO STA 9+66.82 &
FROM STA 15+17.11 TO STA 18+46.93

TYPSECTS.DWG

LOWER AREA ONE
SECTIONS
HAUL ROAD THRU MPTP SITE

FIGURE #2

MSE-HKM
ENGINEERING

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ATTACHMENT 3

LAO Contractor Health and Safety Plan

BARNARD CONSTRUCTION

COMPANY, INC.

LOWER AREA ONE-PHASE I SEGMENT II

CLARK TAILINGS CWMA OPTION

SITE-SPECIFIC SAFETY AND HEALTH PLAN

REVISED FOR 1997

BARNARD CONSTRUCTION COMPANY, INC.

LOWER AREA ONE-PHASE I SEGMENT II
CLARK TAILINGS CWMA OPTION
SITE-SPECIFIC SAFETY AND HEALTH PLAN

REVISED FOR 1997

SITE-SPECIFIC SAFETY AND HEALTH PLAN

I. GENERAL INFORMATION

This SITE-SPECIFIC SAFETY AND HEALTH PLAN (SSHASP), in conjunction with the Barnard Construction Company's (Barnard) Health and Safety Manual has been developed to identify, evaluate, and prescribe control measures for safety and health hazards, as well as to provide for emergency response, at the subject sites. This SSHASP format has been developed by BARNARD, and the SSHASP will be completed and fully developed on a site-specific basis by the Barnard Project Representatives, as outlined in the SSHASP. Implementation of the SSHASP, once formulated, will be the responsibility of Barnard. All subcontractors and other affected parties will be subjected to follow this SSHASP. Changes and updates to this SSHASP will be the responsibility of the Barnard's Safety Representative (Bob Kruckenberg). Distribution of all changes and updates will be made by Barnard's Safety Representative (Bob Kruckenberg). Distribution of original copies will be made as follows: Four copies to Barnard, one copy to be kept at the office and one copy to (Dan Schall-Project Manager); and one copy to (Mike Jones-Project Superintendent), one copy to ARCO. Barnard will be responsible for providing a copy of this completed Plan to ARCO for archiving within one week of the completion of this project. Changes and updates shall be made to the on-site and ARCO archive Plans only. Barnard will be responsible for forwarding the SSHASP to all, subcontractors and other parties as required.

SITE AND PROJECT NAME: LOWER AREA ONE (LAO)-PHASE I SEGMENT II CLARK TAILINGS OPTION Butte, Montana

Project Scope and Applicability Test ("TEST")

Is the project, in fact, covered by this program in both scope and as applicable? Answer "YES" or "NO" to the following questions.

1. Is the activity a "clean-up operation" defined in the regulation as "an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleaned-up or in any other manner processed or handled with the ultimate goal of making the site safe for people or the environment"? **YES**

2. Are the materials involved in the project actually classified as "hazardous substances" defined in the regulation as "any substance defined under Section 101(14) or 101(33) of CERCLA, listed by the U.S. D.O.T. as a hazardous material under 49 CFR 172.101, or defined as a hazardous waste under 40 CFR 261.3 or 49 CFR 171.8"? **YES**

3. Will the activities be conducted at an "uncontrolled hazardous waste site" defined in the regulation as "an area where an accumulation of hazardous waste creates a threat to the health and safety of individuals or the environment or both"? **NO**

A project meeting any of these criteria is considered to meet the applicability of the regulation (29 CFR Part 1910.120), and the remainder of this PLAN must be completed and adhered to.

If the project does not meet the Applicability of this program, the results of this TEST must be documented and results discussed with workers, as appropriate.

Medical Surveillance Applicability

For projects deemed to be within the scope and applicability of the regulation, a Medical Surveillance Program may be required. To test for this requirement, consider the following criteria.

Will employees wear a respirator for 30 days or more a year or as required by 29 CFR Part 1910.134? **NO**

Are workers members of a HAZMAT team? **NO**

Has any worker been injured due to an overexposure from an emergency incident involving hazardous substances or health hazards? **NO, not on this site or area.**

Are workers likely to suffer overexposure to hazardous substances exceeding Permissible Exposure Limits (PEL's) or other published exposure limits because of the types of contaminants to be encountered, duration of the project, potential for planned activities to produce overexposure, and/or the results of preliminary evaluation air monitoring?

NO, previous or current monitoring results indicate there has not been exposure above OSHA established Permissible Exposure Limits (PELs) to any of the site hazards.

If future sampling results indicate possible exposures are above OSHA PELs or if site hazardous significantly change, then a Medical Surveillance Program may be adopted if necessary. Barnard's SSO will ensure compliance with any necessary Medical Surveillance Program. Any changes to the Medical Surveillance program will be communicated to all affected parties.

A Medical Surveillance Program is not needed for this Remedial Action

II SITE CHARACTERIZATION

Site Names: Lower Area One-Phase I Segment II, Clark Tailings Option

Site Location: The LAO site is located approximately 0.5 miles west of Butte, Montana adjacent to Interstate 90. The Colorado Tailings is approximately 40 acres. The Butte Reduction Works and related works occupies approximately 80 acres. The Clark Tailings Site lies approximately 1.5 miles south of LAO and is approximately 60 acres.

Approximate size of area where work activities are to be conducted (acres or dimensions):

The entire project encompasses approximately 180 acres.

Summary of Project Objectives:

(Refer to Exhibit A-1 and A-2 in the contract Scope of Work as necessary)

The general description of the work to be completed for Segment II of Phase I. The Scope of Work for each method is varied, but is based on eight stages of Work.

Stage 1 Pilot Excavation Project (completed-Fall 95)

Stage 2 Excavate the Silver Bow Creek diversion area, the temporary channel, and excavate and backfill between the Butte-Silver Bow Sewage Treatment Plant and the existing slag wall (completed Fall 1996).

Stage 3 Excavate the new Silver Bow Creek Channel east and west of MPTP Buffer Zone. Excavated material for 1996 was disposed of at Opportunity Ponds disposal site. Excavated material for 1997 and beyond will be disposed of at Clark Tailings disposal site located 1.5 miles south of LAO, via off road haul trucks on constructed haul roads.

Stage 4 Excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill the new Silver Bow Creek channel within the Buffer Zone.

Stage 5 Excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill Butte Reduction Works and Colorado Tailings.

Stage 6 Route Silver Bow Creek into low flow channel and excavate (excavated material will be disposed of at Clark Tailings disposal site) area near sewage treatment plant.

Stage 7 Construct west LAO diversion, excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill west area and route Silver Bow Creek in west end low flow channel.

Stage 8 Construct temporary sedimentation pond and excavate (excavated material will be disposed of at Clark Tailings disposal site) and backfill Sedimentation Pond 1 area.

Estimated time for project completion:

Approximately June 1998 or 21 months from project start up date

Anticipated shift schedule (times and days per week): 7:00 a.m. to 6:30 p.m. / 5-6 days per week. Two shifts may by used in the summer months of June, July, August. Total shift time will be from 5:00 a.m. to 9:30 p.m.. Construction work will not be performed once artificial illumination is needed.

ARCO Project Organization:

General Supervisor: Ron Ziegler/Chuck Stillwell
Montana Facility Manager: Sandy Stash
Construction Supervisor: Eric Jacobsen
Environment, Health and Safety Manager: Jim Schrack

Barnard Project Organization:

Operations Manager: Dan Hertel
Project Manager: Dan Schall
Project Superintendent: Mike Jones
Project Engineer: Larry Bowar
Safety Director: Kevin Babcock
Site Safety Officer: Bob Kruckenberg
Lead Foreman: Mike Jenkins / George Maclean

Subcontractor Personnel

O' Keefe Drilling: Dan O'Keefe
Cashell Engineering: John Cashell
Jordan Construction: Joe Jordan/Jerry Vercella/Bob Lash
Mining City Merchant Police: Bob Cuthill

Other Contractor Personnel

RARUS: Kauz McCarthy/Paul McCarthy
MSE/HKM: Dick Talley
PIONEER: Mark Stratton

Agency Oversight

Butte-Silver Bow County: Rick Larson
EPA: Ken Brockman/Larry Smith
State of Montana: Kevin Kirley

III. CHEMICAL HAZARD ANALYSIS

List those Project Tasks or Phases which may pose hazards from chemical exposures.

PROJECT TASK OR PHASE	CHEMICAL HAZARD
All major construction tasks	Arsenic, Cadmium, Lead

Chemical Hazards:

Types of materials expected to be encountered at the site while doing these tasks or phases:

Arsenic, Cadmium, Lead, low pH soils.

The Barnard Site Safety Officer and Construction Company will ensure that OSHA 1910.1200, the Hazard Communications Standard, is complied with on site.

Chemical contaminants expected to be contained in those materials or chemical products to be used in the tasks that meet the definition of "hazardous substances": Identify those that apply.

Arsenic, Cadmium, Lead

Other: Diesel, Creosote, Gasoline

Applicable MSDS's and/or chemical fact sheets are located in the job trailer. MSDSs for other chemicals will be provided as the chemical are brought on site.

Possible Routes of Exposure:

Skin Contact Inhalation Ingestion

Potential For Exposure over PEL's or Other Published Limits.

Low — Medium High

Past sampling results at LAO and other similar sites with similar hazards have shown no evidence of overexposure above OSHA PELs to cadmium, arsenic, and lead. Other chemicals are stored properly and are in smaller quantities such that exposure potential is minimal. Refer to sampling results in site safety program.

III. CHEMICAL HAZARD ANALYSIS

List those Project Tasks or Phases which may pose hazards from chemical exposures.

PROJECT TASK OR PHASE	CHEMICAL HAZARD
All major construction tasks	Arsenic, Cadmium, Lead

Chemical Hazards:

Types of materials expected to be encountered at the site while doing these tasks or phases:

Arsenic, Cadmium, Lead, low pH soils.

The Barnard Site Safety Officer and Construction Company will ensure that OSHA 1910.1200, the Hazard Communications Standard, is complied with on site.

Chemical contaminants expected to be contained in those materials or chemical products to be used in the tasks that meet the definition of "hazardous substances": Identify those that apply.

Arsenic, Cadmium, Lead

Other: Diesel, Creosote, Gasoline.

Applicable MSDS's and/or chemical fact sheets are located in the job trailer. MSDSs for other chemicals will be provided as the chemical are brought on site.

Possible Routes of Exposure:.

[✓ Skin Contact] [✓ Inhalation] [✓ Ingestion]

Potential For Exposure over PEL's or Other Published Limits.

[✓ Low] Medium High

Past sampling results at LAO and other similar sites with similar hazards have shown no evidence of overexposure above OSHA PELs to cadmium, arsenic, and lead. Other chemicals are stored properly and are in smaller quantities such that exposure potential is minimal. Refer to sampling results in site safety program.

IV. PHYSICAL HAZARD ANALYSIS

List those Project Tasks or Phases which may pose physical hazards to workers at the site.

Project Task or Phase	**Physical Hazard**
All major project tasks	ALL

Potential Physical Hazards: Underline all that apply

A) Cold Stress B) Heavy Equipment Operation C) Heat stress D) Excavation E) Trips/Falls

F) Material Handling G) Manual Lifting H) Noise I) Natural Hazards

J) Electrical Hazards K) Traffic Control (Heavy Equipment/Public Traffic) K)Other Hazards

Refer to Barnard's Safety Manual for safety programs covering the above mentioned hazards.

V. TRAINING REQUIREMENT ANALYSIS

Have all workers for the project received applicable training, as outlined by 29 CFR 1910.120(e)_YES

Copies of the Training Certificates for all personnel will be kept in the site safety program.

Describe the manner in which site-specific training will be conducted for this project.

Pre-entry briefing-All personnel will be given a pre-entry briefing. Also, an overview of Barnard's Safety Enforcement Policy; Accident and Injury Reporting Guidelines; Drug and Alcohol Program; EEO Policy and our Safety Goals for the project. Task/Safety training will be performed on specific tasks such as excavating and trenching; HAZCOM, hearing protection, heavy equipment operations and other work activities as outlined in the Scope of Work and as determined by Barnarnd.

Describe the elements to be covered in site-specific training: Names of Persons Responsible for Site Safety, Safety and Health hazards on-Site, Use of Personal Protective Equipment, Work Practices to Minimize Worker Risks, Engineering Controls, Decontamination Procedures when needed, Emergency Response.

Bob Kruckenberg will be responsible for Site Safety, compliance, and training.
All employees are responsible for implementing sound safety practices.

List all other planned or required training activities related to this project.

OSHA 40 hour Hazardous Waste Operations and Emergency Response Training and 8-hr Refresher Courses as needed. 24-Hour "On the Job Training" Supervised by persons qualified to provide this training. Other necessary safety training as applicable to the Scope of Work.

Safety Meetings will be held whenever necessary, however meetings will be held at a minimum of once per week lasting at least 15 minutes. Safety Meetings will be conducted on-site.

Bob Kruckenberg is responsible for assuring compliance with the training requirements outlined in Barnard's Safety Manual and any applicable safety training applicable to the Scope of Work.

VI. PRE-ENTRY BRIEFINGS AND SAFETY MEETINGS

Prior to entry onto the site by anyone, a Pre-Entry Briefing (including site-specific training) will be conducted by SSO. The Pre-Entry Briefing at a minimum will cover the following topics:

A. **SITE SAFETY OFFICER:** BOB KRUCKENBERG

B. **TRAINING REQUIREMENTS TO BE ON-SITE:**
40-hour Hazardous Waste and Emergency Response (HAZWOPER) certification with 8-hour refresher and Pre-entry briefing.

C. **LOCATION OF SITE-SPECIFIC HEALTH AND SAFETY PLAN; MSDS; BARNARD'S SAFETY MANUAL.** SSHASP, MSDS and Barnard's Safety Manual will be located in Barnard's project trailer and in the on-site employee trailer.

D. **PPE REQUIRED WHILE ON-SITE:**
At a minimum, hard hat, steel toed boots, orange safety vest and safety glasses with side shields shall be worn at all times in the exclusion zone.

Ear plugs shall be required while operating all heavy-equipment or while working in the near vicinity of heavy-equipment.
(This includes generator sets and other equipment which has been identified as a HIGH NOISE AREA)

E. **SITE CHARACTERIZATION:** Location of Exclusion Zone; Contamination Reduction Zone and Support Zone. (Site map is located in the project office and signs are on site also.)

F. **HEALTH AND SAFETY HAZARDS OF SITE:**
CADMIUM, ARSENIC, AND LEAD. Past sampling results of LAO and similar projects (LAO Pilot Excavation) showed no exposure above OSHA PELs to cadmium, lead or arsenic. Barnard will be conducting personnel monitoring during the project and the results of the test will be communicated to all affected parties. Results of sampling in SSHASP.

HEALTH HAZARDS SUMMARY

Contaminant	PEL/REL/TLV	Target Organs	Toxicity	Carcinogen
Arsenic	.01 mg/m^3 (PEL) .002 mg/m^3 (REL) Ceiling .2 mg/m^3 (TLV) IDLH: 100 mg/m^3	skin, kidneys, liver, lungs, lymphatic system	ulceration of nasal septum, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin	Yes
Cadmium	.2 mg/m^3 (PEL) .6 mg/m^3 (PEL ceiling) lowest feasible concentration (REL) .05 mg/m^3 (TLV) IDLH 50 mg/m^3	respiratory system, kidneys, prostate, blood	pulmonary edema, dyspnea, cough, chest tightness, chills, headache, muscle aches, nausea, vomiting	Yes
Lead	.05 mg/m^3 (PEL) .001 mg/m^3 (REL)	GI tract, CNS, kidneys, blood,	weakness, lassitude, insomnia, facial pallor, anorexia, colic, anemia, eye	No

	IDLH - 700 mg/m^3	gums	irritation	

G. HEAVY EQUIPMENT/TRAFFIC SAFETY:: Personnel shall make eye contact with operators and reieve positive confirmation from the operator when working near any heavy equipment. Do not position or park vehicle in equipment blind spots-even if you are stopping for a few seconds. Stay at least 15 feet away from any running or moving equipment. Do not approach equipment unless instructed by operator.
Only Haul traffic and BCCI's supervisors are allowed on haul roads between borrow source/LAO and Clark Tailings Disposal Site/LAO. A safety meeting (JSA's and Work Plans) will be conducted for the Clark Tailing Disposal Option and Borrow Source Haul Road, for all affected employees. Other safety meetings regarding heavy equipment/traffic safety will be conducted as needed, determined by the SSO. Everyone who intends to go onto the site shall observe the haul routes posted on the side of the job trailer, but keep in mind that haul routes are subject to slight variations. All traffic should observe haul traffic patterns before entering the haul route or shall be accompanied by knowledgable site personnel.

Heavy equipment always has the right-of-way. Do not pass heavy equipment. When driving behind any equipment stay in view of the driver's side mirror. Follow posted haul routes and watch for changes. (Posted outside and inside of trailer)

SEAT BELTS WILL BE WORN AT ALL TIMES WHILE ON SITE. (This includes light duty vehicles) The LAO site speed limit is 25 MPH. Higher speeds will be allowed for haul traffic when conditions allow it to be done safely. (Clark Tailings haul max. speed is 35 mph where there are no impeding features and road conditions are good.)
HEADLIGHTS WILL BE USED BY ALL VEHICLES ON SITE. Heavy equipment and light duty vehicles.

H. EXCAVATIONS: No one is authorized to enter any open excavation or trench unless it has been properly protected (i.e., shored, sloped or other) and been deemed safe for entry by the SSO or other appropriate supervisor.

I. OTHER: Trips/Fall hazards, Heat/Cold Stress hazards
UTILITIES-electrical lines and High Pressure Gas Lines, telephone wires, water/sewer lines are located on project.

J. EMERGENCY PROCEDURES:

1. All work will stop immediately All unnecessary equipment shall be moved clear to provide clear access to the emergency site. Control site access roads shall be kept open.
2. Contact SSO/Supervisor/Other Site Personnel who have a radio or cell phone.
3. CALL 911- Site is located at 1200 Centennial Avenue.
4. A foreman or other designated person will go to the gate to meet all responding services.
5. Make area safe for everyone, or isolate hazardous area. Secure the site from further hazards, i.e., turn off utilities, remove hazardous substances not involved, etc.

DO NOT ALLOW ANYONE TO ENTER THE EMERGENCY SITE UNLESS IT IS DEEMED SAFE.

6. All personnel nearby the accident/injury site shall gather all available First Aid/Rescue equipment.
   First Aid Kit/Eye Wash Station/Stretcher are located in office trailer.
   Fire Extinguishers-located on all heavy equipment and project office .
   For fires in the incipient stage, personnel shall extinguish the fire with a fire extinguisher.

   DO NOT FIGHT FIRES IF THEY ARE BEYOND THE INCIPIENT STAGE.
7. List/Identify personnel trained in First Aid/CPR.
8. Emergency numbers and map to hospital are located in office trailer.
9. Do not discuss details of incident with media. You may discuss details of incident with proper emergency or responding personnel.
   Barnard/ARCO will be responsible for all communication with media personnel.

K. DECONTAMINATION PROCEDURES:

Location of decontamination station(s). Outside of office trailer and on-site.

L. EQUIPMENT/VEHICLES: All heavy equipment that permanently leaves the site shall be decontaminated with a power washer which includes washing tires, under carriage, boxes and any other visible contaminants. Haul traffic and light duty vehicles leaving and returning to LAO do not need to be decontaminated every time they leave the site, unless there are obvious contaminants which could be deposited outside the site on roadways or other areas. SSO or Barnard personnel shall inspect equipment prior to leaving site.

M. PERSONNEL DECONTAMINATION: Boot brush and wash station shall be used prior to leaving site and prior to food consumption.

Site Safety Meetings will be conducted with workers, as necessary, to keep personnel apprised of changes to the PLAN, as well as changes in site conditions or operations that may impact safety and health hazards. Records of Safety Meetings will be kept in the Site Safety Program.

VII. ENGINEERING CONTROLS, WORK PRACTICES AND PERSONAL PROTECTIVE EQUIPMENT

Based upon the Chemical and Physical Hazards Analyses, and the associated risks, specify Engineering Controls and Work Practices to be implemented by a Project Task or Phase. Examples include covering materials with clean soil, wetting down materials to eliminate exposure possibilities, and use of closed cabs on equipment.

DUST SUPPRESSION/SITE SAFETY

The work described in this Plan has the potential to generate airborne dust. Measures shall include the application of water or chemicals to haul roads and access roads to suppress dust during the project.

If PELs and other published exposure limits may be exceeded even with the implementation of Engineering Controls and Work Practices, select the appropriate level of PPE by Project Task or Phase.

Level of Protection for all tasks will be level D unless deemed otherwise.

Level D is described as Steel toed boots, orange safety vest, safety glasses with side shields, and a hard hat. This ensemble will be the minimum protection while in the exclusion zone for the above mentioned tasks. Gloves will be used as needed.

The particular brands of safety equipment need not be specified.

For respirator usage to protect workers from iron, zinc, manganese or cadmium employees must use a NIOSH/ MSHA approved half or full face respirator with a HEPA filter.

Barnard's Safety representative will be responsible for choosing the proper respiratory protection based on worker exposure data and employee needs. For nuisance dust a NIOSH/MSHA approved cloth respirator will be used.

Refer to Barnard's Safety Manual procedures for maintenance and care of PPE.

Maintenance and care of PPE is the responsibility of each individual employee with the SSO ensuring compliance.

VIII. AIR MONITORING REQUIREMENT ANALYSIS

All air monitoring will be conducted in accordance with published ACGIH, OSHA or other applicable guidelines. Monitoring will be conducted in accordance with any applicable terms of the ARCO/Barnard Contract.

Initial Entry Monitoring

Is the site and task well-characterized and/or previously monitored? **YES**

If "YES", attach results of these analyses to this PLAN and go on to next section, "Site Control". Copies of monitoring results will be kept in the SSHASP.

Periodic Monitoring

Will Periodic Monitoring for IDLH or other hazardous atmospheres be necessary throughout the project? **NO, unless deemed necessary by SSO.**

Personal (Worker) Monitoring

Is it known with a high degree of certainty (based upon the Initial Entry Monitoring or other data) that worker exposures will not exceed PELs or other published exposure limits?_**YES**

If "YES", describe decision rationale and attach supporting documentation.

Similar projects where sampling has been conducted showed that exposure to the described particulates were below the established OSHA PEL's. Refer to SSHASP for sampling results.

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Personal (Worker) Monitoring

Is it known with a high degree of certainty (based upon the Initial Entry Monitoring or other data) that worker exposures will not exceed PELs or other published exposure limits?_**YES**

If "YES", describe decision rationale and attach supporting documentation.

Similar projects where sampling has been conducted showed that exposure to the described particulates were below the established OSHA PEL's. Refer to SSHASP for sampling results.

IX. SITE CONTROL EVALUATION AND ANALYSIS

Site Communication

Are conditions expected that would render verbal communications difficult or impossible?

YES

Working in and around loud heavy equipment may make verbal communication difficult. When verbal communication becomes difficult, hand signals and/or 2-ways radios will be used.

PROJECT WORK ZONES

Support Zone--(outer boundaries will be marked with orange markers-this area, in general, covers an area 100 yards wide from the North gate to the south end of Barnard's construction trailer.)

Exclusion Zone--(the entire site except the Support and Contamination Reduction Zone)

Contamination Reduction Zone (south end of office trailer, west of trailer, and in lunch trailer)

Refer to Site Map posted on the inside of Barnard's trailer.

Barnard shall establish appropriate decontamination areas, and decontamination Procedures. These decontamination areas shall consist of:

A). A Vehicle Decontamination Area is located west of Barnard's trailer. All heavy equipment leaving the site permanently will be required to go through proper decon procedures and pass inspection of the SSO. Haul traffic and Light duty vehicles leaving and returning to LAO will not be required to go through decon procedures unless there is an excess amount of contamination on the vehicle. Decontamination procedures are as follows:

1. Spray off tires;
2. Spray off blade/box/bucket, and;
3. Spray off any other visible contamination.

B). Barnard shall furnish and install a mobile personnel cleanup trailer that provides a wash area and boot brush. Personnel and subcontractor personnel are only expected to be subject to minor contact with mine tailings, which can be removed by brushing off and/or washing with soaps/ detergents and rinsing with water. Barnard will also provide soap, water, and disposable towels for hand and face washing. A personnel decon station with soap, water,

paper towels, trash can, boot spray and boot brush is positioned on the south end of Barnard's trailer.

Site Security

List all planned precautions to secure the site from unauthorized personnel entry during off-hours.

A security gate that is controlled from the job trailer or similar type of means will be used to provide security. Access roads to LAO from borrow sources and Clark Tailings disposal site will be controlled using flagging personnel (who are trained in site security procedures) during operations and security gates when roads are not in use. Appropriate signs and other safeguards will be used as needed.

If security problems become a concern, Barnard will develop and implement other measures necessary to protect the site.

X. DECONTAMINATION PROCEDURES

List the equipment and rinsing agents to be used for decontamination for this project.

High Pressure washer. Boot brush and hand washing station.

1. Vehicle Decontamination

Because we do not anticipate extensive tailings contamination on vehicles, they will not be decontaminated prior to leaving the site, unless the SSO determines that such action is needed or unless visible tailings on vehicles or spilled tailings on public roads are apparent. Barnard shall provide clean materials on surfaces of access roads entering and exiting the sites, in order that personal vehicles do not become contaminated. The collected soils and sediments shall be incorporated with relocated tailings or disposed of at ARCO's direction.

2. Personnel Decontamination

Barnard shall furnish a wash area. Since personnel are expected to be subject only to minor personal contact with the site material, in nearly all cases any exposure would be limited to contact with boots/shoes. The material on-site can be removed from boots/shoes by brushing off and/or washing with soaps/detergents and rinsing with water. Barnard will also provide soap, water, and disposable towels on the site for hand and face washing.

XI. SITE ILLUMINATION/SANITATIONREQUIREMENTS

Describe illumination plans for the site if night work is anticipated.

Not anticipated.

Describe provisions made for sanitation and potable water at the site.

Portable toilettes will be located throughout the site.

Potable water is provided in the Barnard trailer and near the work location in a water jug.

XII. EMERGENCY RESPONSE AND SPILL CONTAINMENT PLAN

Location map for the hospitals is posted inside Barnard's trailer on the wall. A list of personnel with the name and phone number of a person to contact in case of an emergency is posted on the wall in Barnard's trailer.

ARCO

NAME	DAY PHONE NO.	EVENING PHONE
Sandy Stash	563-5211 x 417 or 490-1128	494-1032
Jim Schrack	563-5211 x 412	490-0804
Ron Zeigler	563-5211 x 418	490-1320
Chuck Stillwell	563-5211 x413 or 4901129	
Eric Jacobsen	563-5211 x 425 or 490-1907	723-7065

Barnard

NAME	*DAY PHONE NO.*	*EVENING PHONE NO*
Dan Hertel	586-1995	585-9032
Dan Schall	723-1121	582-0241
Mike Jones	723-1121	282-7875
Bob Kruckenberg	723-1121	782-2411
Kevin Babcock	586-1995	285-4828

RARUS

Kauz McCarthy	563-2661
Paul McCarthy	563-2821

MT. Western RR

Dispatcher/Bill Blisch	782 - 1240

Burns Security

Ron Wilson	563-3723/491-0056	454-1691
Clean-up Contractors		
AETS	782-4201	800-735-8964
Olympus, Helena	443-3087	
ROAR Tech, Spokane	509-535-6757	
Police, Fire, Ambulance	911	
Disaster Emergency Services, Montana State Emergency Response Coordinator	800-426-9440	444-6911
Disaster Emergency Services, Silver Bow County	782-1515	782-5411
Disaster Emergency Services, Anaconda-Deer Lodge County	560-4000	563-5174
Agency Contacts		
National Response Center	800-424-8802	
EPA Oversight		
Larry Smith	855-2047	
Ken Brockman	855-2046	
State Department of Environment Quality, Superfund Group		
Neil Marsh	444-1420	
Jim Scott	444-1401	

MEDICAL FACILITIES:

Saint James Community Hospital, 400 South Clark, Butte, MT. 59701

Phone 911 or 782-8361

ATTACHMENT 4

Air Monitoring Program for Clark Tailings Hauling Activity

AIR MONITORING PROGRAM
FOR CLARK TAILINGS HAULING ACTIVITY

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AIR MONITORING PROGRAM FOR CLARK TAILINGS HAULING ACTIVITY

INTRODUCTION

Material (mostly mine tailings) from the Lower Area One (LAO) site will be hauled to the Clark Tailings site and capped. Hauling activity from LAO is anticipated to begin in Spring, 1997, by Atlantic Richfield Company (ARCO). Tailings will be excavated and loaded at LAO, transported south across the Montana Pole and Treatment Plant (MPTP) site, across Greenwood Ave., and deposited in the Clark Fork Tailings repository. The haul route extends for approximately one mile south and travels near two residential areas. This document describes the air monitoring program which will be implemented to monitor for potential fugitive dust generated from the hauling activity.

Previous air monitoring test data at similar ARCO Superfund sites have shown particulate matter and metals to be consistently below Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) standards. Air monitoring conducted at MPTP during the 1996 construction season, likewise, indicates fugitive dust levels were below the action level of EPA standards. Even so, air monitoring for particulate matter and metals will take place at strategic points along the haul route to Clark Tailings and at Clark Tailings to assure public safety.

PURPOSE

The primary purpose of this air monitoring plan is to control dust during the LAO/Clark Tailings project. This air monitoring program will be implemented in response to concerns expressed by Butte-Silver Bow citizens regarding construction, and it will verify that the amount of dust generated from hauling activities does not cause exceedances of EPA ambient air standards. Upon receiving analytical air monitoring results for particulate matter and/or metals, ARCO will initiate prompt corrective action in the very unlikely event of an air standard exceedance.

METHODOLOGY

EQUIPMENT

A size selective high-volume sampler--or PM10--will be used for the collection of samples to be analyzed for particulates ≤ 10 µg (micrograms) in diameter. PM10 sampling for airborne particles involves sampling a large volume of atmosphere, approximately 58,000 cubic feet, at a rate of 40 cubic feet per minute for 24 hours. Air is drawn into a covered housing, through a size-selective inlet, and through a filter by means of a high flow-rate blower, so that particulate material collects on the filter surface. This flow rate allows suspended particles having a 50 percent cut point diameter of 10 µm

Stokes equivalent diameter to be collected. Quartz filters are generally used for sample collection. The volume of air sampled is determined from calibration data for the sampler, used in conjunction with stagnation pressure readings taken before and after each sample run. The sampler shall be calibrated using a reference orifice initially and whenever brushes are replaced. The orifice is a working standard which, in turn, has been calibrated against a rootsmeter certified by traceability to standards of the National Institute of Standards and Technology (NIST).

A PM10 air monitor was chosen because it measures the size of particles that directly affect human respiration and because there are environmental standards based on this size particle. Quartz filters will be utilized and calibration will be done against a primary standard.

A TSP sampler will be used at the Montana Pole and Treatment Plant because the lead standard is based on a TSP measurement. TSP samplers measure total suspended particulate of all sizes.

A Miniram will be used to detect air quality daily. A Miniram is a portable monitor which offers real-time determination of total or respirable dust by using near forward infrared light scattering techniques. It can sense dust in concentrations from 0.001 to 200 mg/m^3. The Miniram will be correlated to the PM10 sampler so that Miniram results can be correlated and extrapolated to the PM10 standards.

SET UP AND OPERATIONS

PM10 monitors shall be set up in accordance with 40 CFR 58:

- Placed 20 meters away from trees, buildings, or other large obstacles;
- Placed such that the sampler inlet shall be >2 meters from the ground;
- Placed with the sampler base 4 to 6 feet above the ground;
- Not placed near exhaust flues or vents; and
- Not placed near a site of other potential contamination.

Each sampler shall be stabilized with a 2x4 frame and a plywood platform. Four samplers are located on the periphery of the Clark Tailings site. Two are located at the MPTP site. (See Map 1).

Sampler calibration and maintenance will be performed by trained professionals as described in subsequent sections of this plan.

COLLECTING AND ANALYZING FIELD SAMPLES

Sampling will be done by trained ARCO personnel or ARCO contractors. Sampling personnel will have experience in either Occupational Safety and Health or

Environmental Engineering and will carry out the sampling under the supervision of the Environmental Health and Safety Compliance Director.

TYPES OF SAMPLES

PM10 samplers measure particulate matter (i.e., suspended dust) that is less than 10 µg in diameter. Dust collected by the PM10s will be analyzed for both particulate matter and metals (namely lead, cadmium, arsenic, copper, and zinc).

Only particulate matter and lead have promulgated EPA standards. Cadmium, arsenic, copper, and zinc shall be analyzed to detect their presence and in accordance with Montana Department of Environmental Quality guidelines. The primary standard for particulate matter, adopted to protect human health, limits PM10 concentrations to 150 micrograms per standard cubic meter (µg/m^3) as a 24 hour average concentration. The secondary standard, adopted to assess the impact of pollution on public welfare, is the same as the primary. This standard is attained when the number of exceedances per calendar year is equal to or less than one (40CFR50.6).

It is believed that the smaller particles that the PM10 measures are able to reach the lower regions of the human respiratory tract; they are thus responsible for most of the adverse health effects associated with suspended airborne particulates.

Lead, when collected on a TSP (total suspended particulates) sampler, has an ambient air standard of 1.5 µg/m^3 per calendar quarter in accordance with EPA standards (40CFR50.12) and 1.5 µg/m^3 per 90-day average in accordance with MDEQ regulations. A Montana Pole and Treatment Plant (MPTP) TSP monitor will be utilized for lead analysis.

A Miniram is a portable monitor which offers real-time determination of total or respirable dust by using near forward infrared light scattering techniques. It can sense dust in concentrations from 0.001 to 200 mg/m^3. The Miniram results will be correlated to the PM10.

The diesel exhaust generated during hauling activities is anticipated to be similar to that on the Montana Pole and Treatment Plant (MPTP) project; no diesel exhaust problems were encountered at that site. Also, the haul road and Clark Tailings are fairly wide open areas where smoke should disperse and not create problems. If there are complaints of nuisance smoke, A TMX 412 hand held gas monitor shall be used to measure carbon monoxide and carbon dioxide in diesel exhaust. Particulate matter in diesel exhaust will be measured by the PM10 and TSP samplers described above. Engineering controls will be implemented, if necessary, to ensure protection of public health.

MONITORING LOCATIONS

Four PM10 and three TSP air monitors will be strategically placed along the haul route. Because the primary concern is public safety, monitors will be placed near two residential areas in the prevailing downwind direction from the hauling activity. These locations will measure the actual exposure of fugitive dust to residents south and east of the haul route and Clark Tailings. No neighborhoods nor residents are located within a reasonable distance in any other direction. A map of the haul route and surrounding area showing the locations of PM10s is attached as Exhibit A. Locations of the seven air monitors are as follows:

1. One TSP downwind (east) of MPTP--existing DEQ sampler may be used;
2. One TSP upwind (west) of MPTP--existing DEQ sampler may be used;
3. Two PM10s downwind (east) of Clark Tailings and west of the South Montana Street residential area. (this will be a co-located site);
4. One TSP downwind (east) of Clark Tailings;
5. One PM10 south of Clark Tailings at the tailings periphery; and
6. One PM10 upwind (west) of the Clark Tailings near Little Basin Creek Road.

Two TSP samplers will be located at the MPTP: one upwind and one downwind from the haul road. Two co-located PM10s will be located approximately 1000 feet from the Clark Tailings and approximately 200 feet from the residential area. A TSP will also be located 1000 feet east of the Clark Tailings, in proximity to the co-located PM10s. A fifth sampler will be located upwind from the Clark Tailings approximately 500 feet west of the western edge of the county landfill. And finally, a sixth sampler shall be placed at the southern periphery of Clark Tailings approximately 300 feet from a residence. Each sampler power supply shall be equipped with a ground fault interrupter (GFI) and a surge suppresser to protect operating personnel and the equipment.

Real-time monitoring samples will be collected with the Miniram at various locations along the haul road and at Clark Tailings. The Miniram is a portable monitor that can be set for instantaneous readings or 8 hour sampling. Its portability allows monitoring location flexibility.

MONITORING FREQUENCY

Baseline air monitoring data will be acquired in the following ways:

1. Sampling will be done every third working day during the week prior to hauling. Data results will be compared to data obtained during hauling.
2. Monitoring will be performed at upwind sites during hauling activities. Data results will be compared to data collected downwind during the hauling activity.

3. Historical TSP data collected at the Montana Pole and Treatment Plant (June 1996 to January 1997) has been provided to ARCO for data comparison.

For the duration of LAO removal activity, PM10 and TSP sampling will be done every third operating day at each site. However, in the wet months of spring and fall or if sample results deem appropriate, sampling may be performed less frequently--such as every 6th day--pending approval by the Butte-Silver Bow Health Department, ARCO, and the agencies. Metals analyses will be performed on the three highest PM10 samples per quarter beginning in March or April 1, 1997. Air quality conditions will be monitored by a Miniram at least twice a day. Miniram results will be correlated to PM10 standards. Samples will be collected and analyzed throughout the course of the LAO removal action. Each PM10, TSP, and metal sample shall collect dust for 24 hours (midnight to midnight) to coincide with the industry standard.

This pattern of frequency may change as work progresses. It may increase if conditions demand; it may decrease if sampling test data reveals no exceedance, and conditions are such that continuing low levels of particulate matter and metals are expected. It may decrease only if agreed upon between ARCO, the Butte-Silver Bow Health Department and the agencies.

If the monitoring frequency should change, TSP monitoring frequency will change correspondingly to the PM10's frequency.

Real-time Miniram sampling will be conducted as conditions dictate, but at least twice daily throughout the project.

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Qualified MSE/HKM personnel will provide the initial set up to ensure the samplers are properly running and calibrated. Thereafter, routine sampler calibration will be done by trained ARCO or contractor personnel. MSE personnel will provide a quality assurance audit for calibration and sampler flow rate once per quarter.

Data precision will be assessed using co-located samplers at a site downwind from the Clark Tailings and west of the South Montana Street residential area.

Sample analysis will be done by MSE using contract lab protocol (CLP). Sampling and analysis will include 10% blanks for quality assurance. Throughout sampling, appropriate chain of custody will be maintained.

The entire process will be performed in accordance with EPA reference methods as stated in 40 CFR 50, Appendix J. Quality assurance will be in accordance with EPA 40 CFR 58, Appendices A and B.

SAMPLE ANALYSIS

A professional laboratory will analyze filters gravimetrically for particulate matter. Each sample collected at the frequency previously discussed will be analyzed for PM10 and TSP. TSP will be used to assess lead exposure according to the standards listed in Table 1.

The three highest weight samples will be further analyzed for five metals: arsenic, cadmium, copper, lead, and zinc.

The results of the gravimetric analysis, TSP lead analysis, and five metals analysis will be compared to the appropriate standards. Standards to be used for this project are shown in Table 1.

TABLE 1. Ambient Air Standards

	EPA Primary (µg/m^3) 24-hour average concentration	EPA Secondary (µg/m^3) 24-hour average concentration	MDEQ (µg/m^3) 24-hour average concentration
PM10	150	150	150
As	none	none	0.079
Cd	none	none	0.079
Cu	none	none	1.57
Pb*	1.5*	1.5*	0.393
Zn	none	none	39.29
Miniram Respirable Dust	to be correlated	to be correlated	N/A

*Lead concentration , as monitored on a TSP sampler, is described as per quarter (EPA) or per 90 days average (MDEQ).

A rigorous QA/QC program will be observed for sample analyses. All metals analyses will be performed using CLP protocols. A blank filter will be analyzed for every 10 samples collected. Sample splits will also be performed on a one-in-ten bases. Additionally, the analytical laboratory will participate in EPA's "lead strip" program. This involves analysis of a strip of material with an unknown (to the laboratory) lead concentration. A comparison of laboratory results against the known values then is provided by EPA, providing a measure of laboratory accuracy.

Qualified ARCO personnel will review laboratory results and will notify ARCO field supervision to take additional action to abate any exceedances as necessary. Furthermore, real-time Miniram data will be evaluated daily to determine if additional actions are necessary. Such actions will include additional water application, chemical applications,

surfactants, or other measures. (Corrective actions and off-duty dust control measures are further described in Addendum 1 to the Lower Area One Work Plan/Design Report.) All analytical data will be recorded and fully documented.

Copies of results will be provided to the Butte-Silver Bow Health Department daily (or as otherwise available) and the Environmental Protection Agency (EPA) monthly. For additional information, the ARCO Site Representative may be contacted.

MONITORING EVALUATION

Sampling results will be scrutinized throughout the duration of activity. Every data set collected shall be compared to standards. Trends (either up or down) will be identified. Confounding factors shall be taken into consideration. Climatic conditions shall be noted. Windy days shall be compared to normal days of no wind. Days where dust is being generated from an extraneous source shall be noted.

As stated previously, monitoring frequency may increase or decrease under certain circumstances. It may increase if conditions or public opinion demand; it may decrease under certain conditions. If there are no exceedances in the first month and/or the month of worst-case scenario, sampling frequency may be decreased in accordance with industry standards. Sampling frequency may decrease only if agreed upon between ARCO, the Butte-Silver Bow Health Department and the agencies. Sampling frequency shall be based on sampling results.

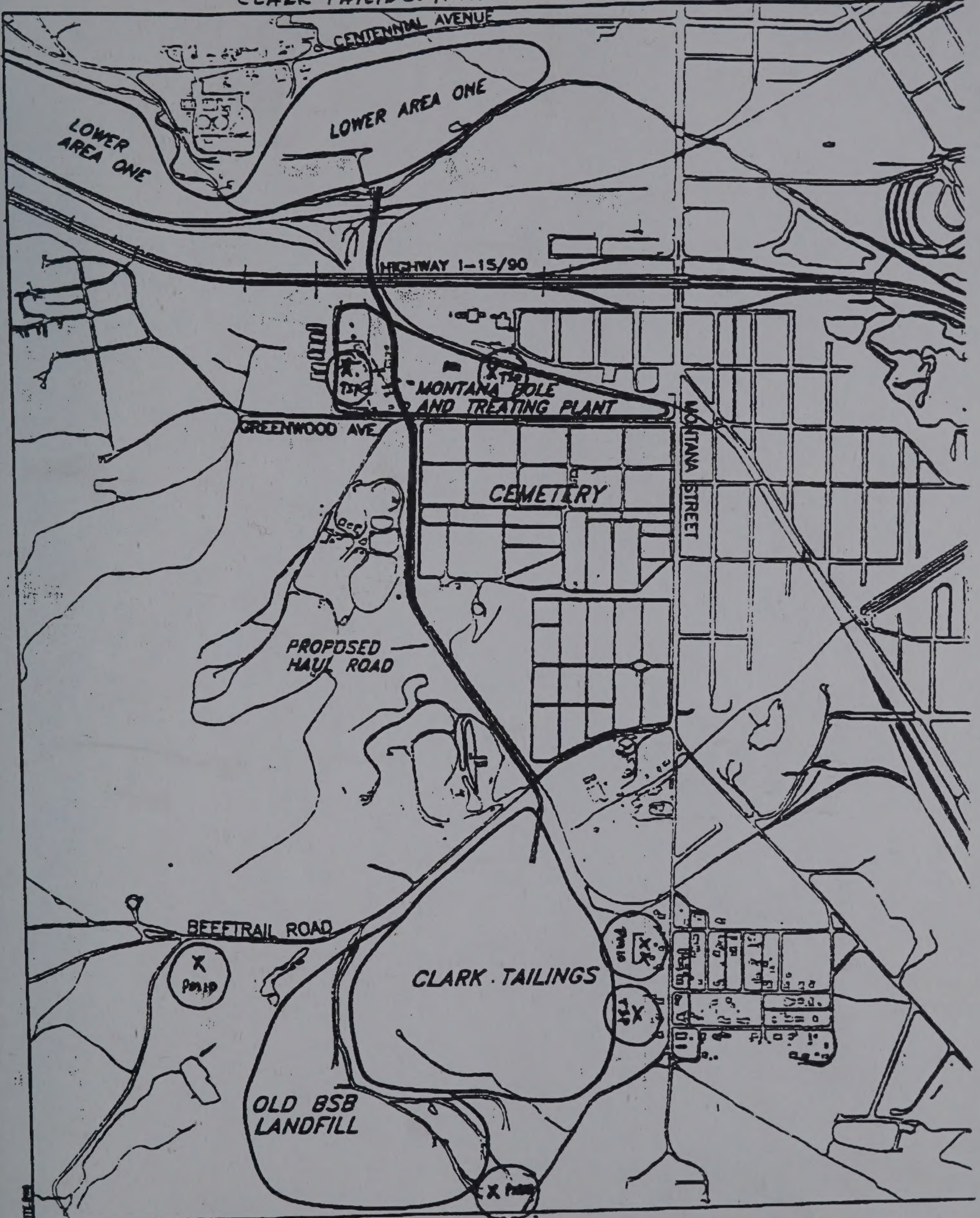
CONCLUSION

As required by the local government and agencies, ARCO has compiled an air monitoring plan to verify dust control is being performed adequately. The plan includes gravimetric analysis, metals analysis, and spot checking. In performing this plan as described, this monitoring plan will enable verification that dust control practices are implemented effectively while the hauling activity takes place thereby keeping the public safe and minimizing nuisance.

EXHIBIT A

HAUL ROUTE MAP

CLARK TAILINGS HAUL MONITORING LOCATIONS.


CENTENNIAL AVENUE
LOWER AREA ONE
LOWER AREA ONE
HIGHWAY I-15/90
TSP
TSP
MONTANA POLE AND TREATING PLANT
GREENWOOD AVE.
CEMETERY
MONTANA STREET
PROPOSED HAUL ROAD
BEEFTRAIL ROAD
Pm10
CLARK TAILINGS
Pm10
TSP
OLD BSB LANDFILL
Pm10

MAP 1

PROPOSED HAUL ROAD: LAO TO CLARK TAILINGS

File -
Old Butte L.F #20
Closure
04

Corrective Measures Assment binder in bookcase

Montana Department of

Environmental Quality

MEMO

To: Brad Archibald
From: Pat Crowley
Date: January 23, 1997
Subject: Final Draft CMA for Old Butte Landfill/Clark Tailings

I have several comments on the Final Draft of the Corrective Measures Assessment. If these items are addressed, then we can quickly proceed to the required public meeting.

1) We concur with the conclusion stated in the CMA that the proposed placement of LAO wastes on the Clark Tailings would constitute a post October 9, 1991 waste placement and thus subject the area to the current solid waste unit closure requirements. If no additional wastes are placed, then the closure of the Clark Tailings will need to be addressed.

2) It appears that fine grained material could infiltrate the capillary break and eliminate its effectiveness. A geotextile fabric may be needed over the capillary break. Please also state the design criteria for the selection of the capillary break thickness.

3) The point of compliance listed in the draft CMA and the monitoring required must be corrected. The Department is concerned that the monitoring system proposed may not be able to detect the COCs as proposed. (See letters from Crowley, June 10, 1996, and January 17, 1997.)

4) The diversion ditch crossing the tailings should be lined to prevent infiltration or be steep enough to preclude infiltration. The design of all ditches must include appropriate BMPs to prevent erosion.

5) The amphitheater shown on Figures 9-1 and 9-3 must be self draining and not impound water.

6) Infiltration in the Timber Butte Sedimentation Basin must be controlled. The area around the perforated riser should be excavated, synthetically lined and bonded to the riser, and then backfilled with suitable clean material. This Sedimentation Basin is a major source of recharge through the Clark Tailings.

7) What will be done in the event that Alternative 8 does not correct the ground water contamination as proposed? The Department has granted three other landfills in the Montana a two year period to demonstrate that the landfill gas extraction systems are effectively correcting their VOC problems. The Butte Landfill will be granted an equal period for their demonstration, unless the monitoring system design will require some additional time to demonstrate the impact. A minimum of quarterly samples for VOCs have also been required to establish a sufficient

statistical basis for the decision. In the event that no effective remediation is demonstrated within trial period, and the sampling does not show a clear trend towards VOC reduction to below the MCL/HHS, the then additional measures must be considered for implementation.

8) On page 2-5 of the CMA, it states: "Transmissivity was measured in the alluvial aquifer at 7,275 ft^2/day at a location 2 miles east-northeast of the landfill site." This should result in a quick flushing of the aquifer beneath the tailings with the cessation of recharge of metal contaminated waters from the tailings once the cap is in place, provided that the tailings are not located below the water table. Please define the extent of tailings on the cross section Figure 2-4. The relationship of tailings to the water table is critical for the evaluation of the effectiveness of the proposed alternatives. An explanation of the relationship of the base of the tailings to the ground water table needs to be includes in the material presented in the CMA. The transmissivity also provides an explanation for the low levels/non-detection of contaminants in wells located in the Blacktail Creek alluvium. Detection is limited by high dilution factors. The contaminants are probably there, it is just a statistical sampling problem.

9) A clear time table needs to be presented in the CMA according to ARM 17.50.710(7)(d). If the remediation activities in the Preferred Alternative are not successful, then other remedies may be necessary in the future.

10) The Department is in possession of two 1992 work plans for the *Hydrogeological and Soils Study* by SRM but I was unable to locate the final report referenced in the CMA. Is this a possible reference to the Stage II report by SRM?

11) A Storm Water Discharge Permit will be need for this site during construction.

12) Construction and demolition debris are also Group II wastes.

13) How do you know there are no organics at the proposed point of compliance wells? No testing for organics has been done in CLK-1 or 2. (See pg SE-2, para 3.)

14) What interim measures need to be implemented for the proposed alternative, if any?

15) To the best of my knowledge, the EPA has not amended the LAO order yet to allow for transport of wastes to the Clark Tailings. (See pg 1-1.)

16) Treatment of Below-Detection limit Data. (See pg 5-1.) Refer to EPA 1992, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities.* pg 25 for guidance. If detected but not quantified below the PQL (a star value), use 1/2 the PQL. If a "J" or "E" value is estimated below the PQL, use the estimated value. For data sets with large numbers of "U" or "non-detect" values, these values should be assigned a different rank from "detected but not

quantified" values.

17) Since the Clark Tailings are from a mill that processed zinc, it seems likely that the results in CLK-1 are from the Tailings.

18) Based on the storm run-off last February that I witnessed at the landfill, I believe that there are some impacts to Grove Creek from the landfill and the Clark Tailings at times. The hydrology of the creek is not well understood.

19) The VOC contamination in BSB-A6 appears to be diluted from the amounts in BSB-A3 and A4 in a manner consistent with the distance from the landfill. It does not appear to be localized phenomenon as stated on page 5-8. It appears to be located in the general VOC plume. Additional plume delineation is not required at this time.

I think this list covers most of the major points. The time schedule was a little tight. I will call you if I find anything else.

MARC RACICOT, GOVERNOR
1520 E SIXTH AVE
PO BOX 200901

STATE OF MONTANA

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HELENA, MONTANA 59620-0901

DEPARTMENT OF
ENVIRONMENTAL QUALITY

FAX TRANSMITTAL

DATE: 1/23/97

ATTENTION TO:

COMPANY NAME:

FAX NUMBER: ( )

FROM: Pat Crowley

FAX NUMBER: ( )

PHONE NUMBER: (406)

COMMENTS: TO: BRAD ARchibald
Chuck Stilwell
Jim Johnson
Wm. Kirley

TOTAL NUMBER OF PAGES TRANSMITTED: 4
(Includes cover page)

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Reviewed by
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N Marsh

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DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITTING & COMPLIANCE DIVISION
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January 16, 1997

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To J Johnson		From P Crowley	
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Fax # ~~723~~- 6866		Fax #	

Jack Lynch
Chief Executive
Butte-Silver Bow
155 West Granite
Butte, MT 59701

Sandra M. Stash, P.E.
Montana Facilities Manager
ARCO
307 East Park Avenue
Anaconda, MT 59711

Dear Jack and Sandra:

Thank you for your November 26, 1996 reply to my letter of June 10, 1996 concerning the closure of the Old Butte-Silver Bow Landfill and the Clark Tailings. I had a very productive meeting with members of your staffs on December 3, 1996, while I was in Butte on other business. We discussed the letter and I promised I would give written response on the items of discussion.

1. Additional Ground Water Data.

We all agreed that the proposal to install an additional well downgradient of the Clark Tailings is a good idea. The exact location of the well near the junction of Beeftrail Road and the railroad grade should be determined by Butte-Silver Bow and ARCO based on site accessability and avoidance of excessive amounts of tailings or railroad grade material in the hole. The results from this monitor well will be included in the final version of the Corrective Measures Assessment.

2. LAO Clayey Material for Clark Tailings Cap.

The results of the leachability test are problematic. While none of the samples exceed TCLP standards and are thus not a hazardous waste, they all show some leaching of metals. The origin

of the metals may be either the tailings or the product of soil formation in a mineralized area. Sample CTTP-C2 leaches lead at 90 ppb. The Human Health Standard for lead in water is 15 ppb. It is curious that only one of the three samples showed lead at this level. Does this indicate a sampling problem or an analytical problem? This needs to be addressed. There is also apparently some confusion over what analytical precision should be obtained during the testing. EPA Method 1312 does not specify an analytical method after the leaching process. It only states that the method should be appropriate to the regulatory requirements. A method meeting the required reporting value from WQB-7 should have been used since we are dealing with ground water standards. Materials that leach metals at levels above a ground water protection standard (MCL or HHS) are not suitable capping materials, as stated in the June 10, 1996, letter.

3. Evaluation of Underlying Soils

Thank you for the soils information. Based on this data, the hydraulic conductivity of the cap should be 1.0×10^{-5} cm/sec.

4. Origin of the Cadmium Exceedences in Ground Water

It does seem most likely that the cadmium is from the Clark Tailings. Thank you for your information on this matter.

5. Infiltration Barrier Test Pads

It appears that all of the materials tested can meet the design standard of 1.0×10^{-5} cm/sec permeability. The leachability question remains to be addressed as stated above. The use of a tracked machine for compaction appears to be precluded by the failure of some of the permeameter tests on two of the four test pads. Most landfill caps are constructed with a fully penetrating sheepsfooted roller to ensure proper bonding between the lifts and proper compaction of the cap. The cap design documentation should specify the type of compaction equipment.

6. Point of Compliance

As stated in my letter of June 10, 1996:

> The multi-unit monitoring proposed would not be able to measure the impact of the Old Butte Landfill Unit on ground water and thus not be as protective of the environment as the current monitoring at the landfill, nor would it be able to effectively assess the impact of the corrective measures required to clean up the VOC contamination at the Landfill.

The Old Butte Landfill and Clark Tailings are not one unit. They are two "discrete areas of land

used for the disposal of solid waste". Although they are adjacent, the boundaries of each area can be defined and they even have individual place names. The Clark Tailings received mining waste. The Old Butte Landfill received municipal solid waste, commercial and industrial wastes and construction and demolition waste. Mining waste, which is **not** "regulated by the mining and reclamation laws administered by the department of environmental quality" (See 75-10-203(11)(b) MCA), is a solid waste subject to the Montana Solid Waste Management Act and rules adopted pursuant to that act.

We now need to determine what constituents need to be monitored for each unit. This can be addressed in the Corrective Measures Assessment Study in conformance with ARM 17.50.710(8)(a)(1).

We are anticipating the receipt of the final Corrective Measures Assessment Study and the Closure Design and look forward to working on these projects this summer.

Sincerely,

Pat

F. Patrick Crowley
Solid Waste Regulatory Lead

cc:Mark Simonich, DEQ
Jan Sensibaugh, DEQ
Neil Marsh, DEQ
Ron Bertram, EPA
Jon Sesso, BSB
James Johnson, BSB
Chuck Stilwell, ARCO
Brad Archibald, Pioneer Technical Services

File:Old Butte Landfill closure
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DRAFT

1/10/97
FPL

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Solid Waste Regulatory Lead

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